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AND
MAGAZINE OF NATURAL HISTORY,
INCLUDING
ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND
CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY
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"Omnes res creatæ sunt divinæ sapientiæ et potentie testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomia in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper astimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—*INNÆUS*.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—*BRUCKNER, Théorie du Système Animal, Leyden, 1767.*

. The sylvan powers
 Obey our summons; from their deepest dells
 The Dryads come, and throw their garlands wild
 And odorous branches at our feet; the Nymphs
 That press with nimble step the mountain-thyme
 And purple heath-flower come not empty-handed,
 But scatter round ten thousand forms minute
 Of velvet moss or lichen, torn from rock
 Or rifted oak or cavern deep: the Naiads too
 Quit their loved native stream, from whose smooth face
 They crop the lily, and each sedge and rush
 That drinks the rippling tide: the frozen poles,
 Where peril waits the bold adventurer's tread,
 The burning sands of Borneo and Cayenne,
 All, all to us unlock their secret stores
 And pay their cheerful tribute.

J. TAYLOR, Norwich, 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

" per litore spargite muscum,
 Naiades, et cithara vitreos considite fontes.
 Pollice virgineo teneros hic capite flores
 Floribus et pictum divæ replete canistrum
 At vos, o Nymphæ Craterides, ite sub undas;
 Itæ, recurvato variata corallia trunco
 Vellite muscosis e rupibus, et mihi conchas
 Ferte, Dæa pelagi, et pingui conchyliis succo."
N. Parthenis Gvannattasi, Eol. 1.

No. 13. JANUARY 1899.

I.—*Natural History Notes from H.M. Royal Indian Marine Survey Ship 'Investigator,' Commander T. H. Heming, R.N., commanding.*—Series III., No. 2. *An Account of the Deep-sea Crustacea dredged during the Surveying-season of 1897-98.* By A. ALCOCK, Major, Indian Medical Service, Superintendent of the Indian Museum, and A. R. S. ANDERSON, Captain, Indian Medical Service, Surgeon-Naturalist to the Survey.

DEEP-SEA Crustacea dredged by the 'Investigator,' to the number of about 190 species, have already been described in the following papers:—

J. WOOD-MASON.—J. A. S. B. vol. lvi. pt. 2, 1887, pp. 206-207, pl. i., and p. 376; Ann. & Mag. Nat. Hist., Feb. 1891, pp. 187-202; March 1891, pp. 258-272; Oct. 1891, pp. 269-286; Nov. 1891, pp. 353-362; April 1892, pp. 265-275, pls. xiv., xv.; May 1892, pp. 358-370; Feb. 1893, pp. 161-172, pls. x., xi.

G. M. GILKS.—J. A. S. B. vol. lvii. pt. 2, 1888, pp. 220-231, pls. vi., viii., ix.

W. WELTNER.—SB. Ges. naturf. Freunde, Berlin, 1894, pp. 80-87.

Ann. & Mag. N. Hist. Ser. 7. Vol. iii.

A. ALCOCK.—Ann. & Mag. Nat. Hist., March 1891, pp. 225-245; April 1894, pp. 321-334; May 1894, pp. 400-411; J. A. S. B. vols. lxiv, lxv, and lxvii. pt. 2, 1895, 1896, 1898.

A. ALCOCK and A. R. S. ANDERSON.—J. A. S. B. vol. lxiii. pt. 2, 1894, pp. 141-185, pl. ix.

A. R. S. ANDERSON.—J. A. S. B. vol. lxv. pt. 2, 1896, pp. 88-106.

J. R. HENDERSON.—J. A. S. B. vol. lxv. pt. 2, 1896, pp. 516-536.

Many of the species described in these papers have been figured in thirty-five plates of "Illustrations of the Zoology of the 'Investigator,'" published in the years 1892-1898.

In the present paper we offer a list of 92 species of deep-sea Crustacea obtained by the 'Investigator' between the months of October 1897 and April 1898. Of those species 31 appear to be new to science and 12 more new to the Indian record. This brings the number of species of Crustacea known to inhabit the depths of the Indian seas to something over 230.

Among the more interesting of our new finds are:—

(1) *Pentacheles sculptus*, a species that also inhabits the depths off the Atlantic coast of the United States; (2) a species of *Richardina* (a genus allied to *Stenopus*) differing very little from the type of the 'Travailleur' expedition; (3) a true *Pylocheles*, so much like the Caribbean species described by M. A. Milne-Edwards, that we at first thought it to be the same; (4) a *Munidopsis* that is quite certainly the same as the 'Travailleur' *Galathodes rosaceus* figured by M. A. Milne-Edwards; (5) a *Homola* having the same "macrurous" carapace as the Mediterranean *H. Cuvieri* and very closely related to that species; (6) a curious primitive Dromioid having the same branchial formula as the Caribbean *Homolodromia* of A. Milne-Edwards (not the *Homolodromia* of Miers), and seeming, in fact, to differ from the Caribbean form only in having orbits like those of *Dromia*; (7) a species of the Corystoid genus *Trachycarcinus*—a genus only known hitherto from off the Pacific coast of Central America; (8) two species of the Lithodoid genus *Paralomis*; (9) a *Pinnotheres* inhabiting a species of *Lima* dredged in 430 fathoms.

Of all the dredging-stations of this season the most prolific was one a few miles to the south-west of Wadge Bank, the exact position being 7° 17' 30" N., 76° 54' 30" E., the depth 430 fathoms, and the corrected bottom-temperature "38° Fahr."—though we suspect there is some mistake about the temperature, and that 38° is a clerical error for 48°. A preliminary

sounding brought up "grey mud," but the dredge soon fouled coral and was brought up full of masses of *Caryophyllia paradoxus*, sp. n., *Desmophyllum vitreum*, sp. n., *Lophohelia investigatoris*, sp. n., and *Solenosmilia Jeffreysi*, sp. n. Captain Anderson estimates that there was about half a ton of it—living and dead.

More than 30 species of Crustacea were obtained from this haul, including two of *Parapagurus* and one of *Pagurodes*, two of *Paralomis*, five of *Munidopsis*, one of *Ptychogaster* and two of *Uroptychus*, two Homoloids and one Dromioid, and a *Trachycarcinus*. And of the species of *Munidopsis* one was represented by 237 specimens and another by 52.

One event of this season appears to show that deep-sea dredging may be a matter of mere chance. In December 1890 the ship dredged in 188–220 fathoms off the Cinque Islands (11° 31' 40" N., 92° 46' 40" E.) and made perhaps the best haul of her record, getting her trawl-bag more than half full of solid specimens, of which a multitude of 29 species of Fishes and 23 species of Crustacea formed only a portion. In April 1898 exactly the same spot was dredged—bearings being carefully taken—and although no accident occurred, the results were extremely poor.

In the following list the new species are noted, and the species that are new to the Indian record are marked with an asterisk. All the new species have been figured, and the figures will be published either in the issue of the "Illustrations of the Zoology of the 'Investigator'" for 1899 or in a Report that one of us has now in the press on the deep-sea Brachyura collected by the 'Investigator.'

For the determination of the Macrura the second-named of the joint authors is chiefly responsible, for those of the Brachyura and Anomura the first-named is chiefly responsible.

SCUDZOPODA.

Gnathophausia zoea, Salm, (l. O. Sars. 430 fath.

DECAPODA.

Panopeus rectacutus, Spence Bate. 370 410 fath.
Parapenaeus investigatoris, sp. n. 133 410 fath.
Metapenaeus philippinensis, Sp. Bate. 185 fath.
Haliporus taprobanensis, sp. n. 550 fath.
Aristeus semidentatus, Sp. Bate. 360 430 fath.
 " — *coruscans*, Wood-Mason. 824 fath.
 " — *crassipes*, Wood-Mason. 360 600 fath.
Aristeopsis Edwardsiana (Johnson). 130 fath.

- Benthescymus investigatoris*, sp. n. 370-610 fath.
Sergestes robustus, S. I. Smith. 370-410 fath.
 — *rubro-guttatus*, Wood-Mason. 108 fath.
Crangon andamanensis, Wood-Mason. 185 fath.
Pontocaris media, sp. n. 55 fath.
Glyphocrangon investigatoris, Wood-Mason. 300 fath.
 — *Gilesii*, Wood-Mason. 370-410 fath.
 — *unguiculata*, Wood-Mason. 824 fath.
Alpheus Shearni, sp. n. 430 fath.
 * *Heterocarpus levigatus*, Spence Bate. 430 fath.
 — *gibbosus*, Spence Bate. 185-410 fath.
Plesionika bifurca, Alcock and Anderson. 370-410 fath.
 — *affinis*, sp. n. 172-303 fath.
Pandalus ? *martini*, A. M.-Edw. 101-430 fath.
 * — ? *ensis*, A. M.-Edw. 185 fath.
 — *Alcocki*, Anderson. 360 fath.
 * *Chlorotocus* ? *gracilipes*, A. M.-Edw. 185 fath.
Acanthephyra sanguinea, Wood-Mason. 101-610 fath.
 — *eximia*, S. I. Smith. 408 fath.
Hoplophorus gracilirostris, A. M.-Edw. 185-410 fath.
Palaeonella laccadivensis, Alcock and Anderson. 430 fath.
Nematocarcinus tenuipes, Sp. Bate. 836 fath.
Pasipha unispinosa, Wood-Mason. 360 fath.
Eryonius indicus, sp. n. 824 fath.
 * *Pentacheles sculptus*, S. I. Smith. 824-836 fath.
 — *phosphorus*, Alcock. 370-410 fath.
Nephrops andamanica, Wood-Mason. 185 fath.
Nephropsis Stewarti, Wood-Mason. 185-360 fath.
 — *atlantica*, Norman. 498 fath.
Callinassa lignicola, sp. n. 185 fath.
Calastacus felix, sp. n. 430 fath.
Iconaxius kermadeci, Spence Bate. 360-430 fath.
 (?) *Richardina spongicola*, sp. n. 498 fath.
Pylocheles Miersi, sp. n. 185 fath.
Parapagurus pilosimanus, S. I. Smith. 824-836 fath.
 * — *affinis*, Henderson. 430 fath.
 — *Andersoni*, Henderson. 430 fath.
 * *Pagurodes limatulus*, Henderson. 430 fath.
Paguristes puniceus, Henderson. 370-410 fath.
Paralomis investigatoris, sp. n. 430 fath.
 — *indica*, sp. n. 430 fath.
Munida militaris, Hend., var. *andamanica*, Alcock. 185-410 fath.
 — *squamosa*, Hend., var. *prolixa*, Alcock. 185-191 fath.
 — *microps*, Alcock. 640 fath.
 — *comorina*, sp. n. 430 fath.
Munidopsis stylirostris, Wood-Mason. 824-836 fath.
 — *dasyus*, Alcock. 498 fath.
 — *Hemingi*, sp. n. 430 fath.
 — *iridis*, sp. n. 430 fath.
 — *Goodrigii*, sp. n. 430 fath.
 * — ? *rosacea*, A. M.-Edw. 430 fath.
 — *trifida*, Henderson. 498 fath.
 — *Moresbyi*, sp. n. 430 fath.
Ptychogaster investigatoris, sp. n. 405 fath.
 — *Hendersoni*, sp. n. 430 fath.
 * *Uroptychus australis*, Henderson, var. ? 450 fath.

Indian Deep-sea Crustacea.

- Uroptychus bacillimanus*, sp. n. 430 fath.
— *fusimanus*, sp. n. 430 fath.
— *carirostris*, sp. n. 75-60 fath.
Homola profundorum, sp. n. 430 fath.
— *megalops*, Alcock. 370-119 fath.
Paromolopsis Bousi, Wood-Mason. 430-198 fath.
Hypsophrys longipes, sp. n. 430 fath.
Arachnodromia Baffini, gen. et sp. n. 430 fath.
* *Ethusa gracilipes*, Miers. 836 fath.
— *indica*, Alcock. 360 fath.
Latreidus Channeri, Wood-Mason. 360 fath.
Physaccheus etenurus, Alcock. 185 fath.
Echinoplar pungens, Wood-Mason. 185 fath.
* *Cyrtomalia Sahni*, Miers. 430 fath.
Platymalia Wyville-Thomsoni, Miers. 185 fath.
Seyramathia Rivers-Andersoni, Alcock. 430 fath.
Trachycarcinus glauens, sp. n. 430 fath.
Sphenomerides trapezioides, Wood-Mason. 90 fath.
Benthochaseon Hemingi, gen. et sp. n. 185 fath.
Carcinoplar longipes, Wood-Mason. 430 fath.
Psophticus stridulans, Wood-Mason. 185-419 fath.
Pilumnoplar Sinclairei, sp. n. 430 fath.
Canatopsis rubida, gen. et sp. n. 194 fath.
Ptenoplar notopus, Alcock and Anderson. 185 fath.
Pinnoteres abyssicola, sp. n. 430 fath.

STOMATOPODA.

- * *Squilla leptosquilla*, Brooks. 185-419 fath.

AMPHIPODA.

- * *Cystisoma spinosum* (Fabr.). 172-498 fath.

BRACHYURA.

Family Homolidæ.

HOMOLA, Leach.

Homola profundorum, sp. n.

Carapace very decidedly macruriform, deep, ovoid-triangular, broadest abait the middle of the branchial region, tapering to an acutely spiniform rostrum, of which the length is about a third that of the rest of the carapace. Diverging from either side of the base of the rostrum is a spine of similar form and size. The only other elevations on the carapace are a hepatic spine just behind the hollow for the retracted eye, an antennal spine just outside the antennal base, and a blunt denticle near the middle of the ill-defined lateral border.

The gastric region is well delimited and the *linea anomurica* is broad, conspicuous, and dorsal.

The stout cylindrical terminal joint of the eye-stalks is longer than the slender basal joint; the eyes are of good size, well pigmented, and hemispherical.

The chelipeds are slender, but are stouter than the legs; the arm has the outer lower border spinate and, on the upper border, a few spinules and a strong terminal spine; both the inner and the outer angles of the wrist are armed with a strong spine, the fingers are much shorter than the hand and have the cutting-edge entire.

The legs are slender and subcylindrical, the second and third pair (which are slightly longer than the first) are at least three times the length of the carapace. In the first three pair there are a few distant spines and a strong terminal spine on the anterior border of the merus, a few articulating spinules at the far end of the posterior border of the propodite, and a comb of articulating spines along the posterior border of the dactylus, the last joint being but half the length of the last but one. The dorsal fourth pair of legs are far slenderer than the others and do not reach the end of the merus of the preceding pair; their propodite is triangular, owing to the expansion of its posterior border, and opposes a sharply serrated edge to the less strongly toothed posterior border of the short dactylus, the parts being cheliform rather than subcheliform.

The body and appendages are coated with very short distant bristles, which do not conceal the surface; there are some longer and thicker bristles along the edges of the chelipeds and a very few scattered hairs along the edges of the legs.

Three young females from off the Travancore coast, 430 fathoms.

The carapace of these is about 13 millim. long and about 9 millim. in greatest breadth.

This species is most closely related to *Homola Cuvieri*, Risso, and belongs therefore to the late Professor Wood-Mason's genus *Paromola*.

HYPSOPHRYX, Wood-Mason.

Hypsophrys longipes, sp. n.

Rostrum deeply bifid. *Linea anomurica* distinct.

Four large spines on the anterior border of the carapace, namely, two close together at the base of the rostrum, one at either orbital angle.

Lateral borders of dorsum of carapace well defined, spinulate; the ridge on the side-wall of the carapace that defines the branchial regions anteriorly is also spinulate. A row of spines on the hepatic region, the largest of which is on the lateral border of the carapace and has a spine dorsad of it.

Gastric region obscurely subdivided; each lateral sub-region is armed with five or six large spines, while on the median region there is a central spine, sometimes followed by a row of spinules. Subhepatic and suborbital region with numerous large spines, one of which is "antennal."

Eyes well pigmented. Antennary flagella more than twice the length of the carapace.

Rows of spinules on the exposed surface of the ischium, merus, and exognath of the external maxillipeds, and a row on the basal joint of the antennules.

Chelipeds slender, reaching not far beyond the end of the carpus of the first pair of legs; the arm and wrist not stouter than the meropodites of the first three pair of legs; spinate and spinulate as in the preceding species; fingers as long as the hand.

The second and third pair of legs, which are slightly longer than the first and three times as long as the fourth, are four times the length of the carapace. In the first three pair of legs the merus is compressed and has its anterior border spinate and its posterior borders spinulate; the posterior border of the propodite carries a few distant articulating spinelets, and the dactylus (which is about two thirds the length of the preceding joint) has a close comb of articulating spines along its posterior border.

The fourth (dorsal) pair, which are extremely slender, have the posterior border of the merus strongly spinate; the propodite is several times larger than the minute dactylus.

The terminal joint of the male abdomen ends acutely.

Hairs and bristles are sparsely present, just as in the preceding species.

The carapace of a large egg-laden female is 38 millim. long and 30 millim. broad.

Eleven specimens, representing adults and young of both sexes, were lately dredged off the coast of Travancore at 430 fathoms.

Family Dromidæ.

Arachnodromia Baffini, gen. (?) et sp. n.

Branchiæ 20 on either side, as in *Homolodromia*.

Carapace elongate-oblong, but somewhat broader behind

than in front, deep, inflated, tomentose, unarmed except for a few sharp granules anteriorly and laterally; two creases break either lateral border, the posterior one being continued to the cardiac region as the cervical groove.

Front prominent, horizontal, bifid from its base.

Antennule and eye retractile into an orbit almost like that of *Dromia*. Eye-stalks long and slender, not completely filling their part of the orbit; eyes small, but well-formed and well-pigmented. Antennal flagella longer than the carapace.

Palate well delimited from the epistome; the ridges defining the expiratory canals very distinct; external maxillipeds distinctly opercular, but with a pediform cast.

Chelipeds equal, slender, though considerably stouter than the legs, about $1\frac{3}{4}$ times the length of the carapace, unarmed except for a few sharpish granules, visible only when the dense tomentum is removed; the fingers well calcified, hollowed *en cuillère*, the tip of the dactylus fitting into a notch in the tip of the thumb.

Legs cylindrical, smooth beneath a thick tomentum. The first two pair are more than twice the length of the carapace; their dactyli are stout, are about $\frac{2}{3}$ the length of the preceding joint, and are sharply spinate along the posterior edge up to a terminal claw. The last two pair are about the same length as the carapace, are subdorsal in position, and end in a small claw-like dactylus that shuts down on a circle of spines at the end of the preceding joint.

The sternal grooves of the female end, without tubercles, at the level of the openings of the oviducts.

The abdomen of both sexes consists of seven separate segments; the pleurae of the third to the sixth somites are remarkably large and independent, and the last abdominal tergum is nearly as long as the preceding five combined.

Two males and a female from off the Travancore coast, 430 fathoms.

This species at first sight might be taken for the *Homolodromia paradoxa* of A. Milne-Edwards, in which, however, it is stated that there are no orbits and that the antennules are not retractile.

Family Corystidae.

TRACHYCARCINUS, Faxon.

Trachycarcinus glaucus, sp. n.

Carapace irregularly pentagonal, its surface coated with

short, stiff, club-shaped hairs; the regions well-defined, rather tumid, much subdivided into tumid lobules, of which the convexities are capped by clusters of large conical granules, and the general surface also is studded, especially in the young, with similar granules.

Front narrow, horizontal, prominent, deeply cleft into three prongs of nearly equal size.

Antero-lateral borders half as long again as the postero-lateral, armed with three stout pinnulate spines, not including the outer orbital angle; postero-lateral borders entire, posterior border finely beaded.

Upper orbital wall deeply cleft into three pinnulate teeth, lower orbital border deeply concave, its inner angle strongly spiniform. Eye-stalks slender, rather long; the eyes, which are more ventral than terminal, are dull and faintly pigmented (as in many species of *Munidopsis*), and are non-faceted.

Antennary flagella short, extremely slender, not hairy.

Chelipeds remarkably unequal in the male, equal in the female.

The smaller cheliped of the male and both chelipeds of the female are about as long as the carapace and are coated almost to the finger-tips with stiff club-shaped hairs, which are short except along the upper border of the wrist and hand and of the basal part of the finger, where they are long; beneath the hairs are some scattered granules, and along the upper border of the arm, wrist, and hand are some denticles; the inner angle of the wrist is strongly spiniform, and the far end of the upper border of the hand is dentiform.

The larger cheliped of the male is about twice the length of the carapace, about half its length being formed by the hand and fingers; the greatest breadth of the hand is about half the length of the carapace. It is almost smooth, the upper border of the arm and hand and the inner border and upper and outer surfaces of the wrist alone being furnished with denticles and hairs; the inner angle of the wrist is spiniform.

The legs are covered with short, stiff, club-shaped hairs, which are rather more thick-set on the anterior borders and on the dactyli than elsewhere. The second and third pair, which are rather longer than the first and last pair, are somewhat less than $1\frac{1}{2}$ times the length of the carapace. All the dactyli end in a little claw.

The abdomen of the male consists of seven distinct segments, but the third, fourth, and fifth move together.

In life the animal is covered with a coat of mud held together by the hairs above described, the only bare parts

being the hand and fingers and part of the arm of the larger cheliped of the male.

The colours in life are described by Dr. A. R. Anderson as "white, with a bluish tinge, eyes with a slight reddish opalescence." In spirit the bluish tinge is fainter, the eyes are a pale milky yellow-ochre, and the large hand is ivory-white.

The dimensions of the largest male are as follows:—

	millim.
Length of carapace	18.5
Breadth of carapace	14.5
Combined length of hand and fingers along lower border..	11.75
Combined length of basal joints, arm, and wrist along upper border	15

Fifteen specimens were dredged off the Travancore coast at a depth of 430 fathoms. The bottom consisted chiefly of coral (living and dead).

Several of the specimens were egg-laden females. The eggs are comparatively few in number and are large, their diameter being about 1.3 millim.

This species is very like *Trachycarcinus corallinus*, Faxon, which was dredged by the 'Albatross' off Panama and the Pacific coast of Mexico at depths of 546–695 fathoms. It differs from that species in the following particulars:—

The carapace is more granular and its lobules are capped by blunt conical spinules, *not* smooth tubercles, and its posterior border is finely and irregularly beaded, *not* dentate.

The front is deeply cut into three spines or prongs of almost equal size, *not* into three teeth of which the middle one is larger than the others.

The eyes, though very pale, are distinctly pigmented, *not* devoid of pigment.

The inner angle of the wrist of the smaller cheliped is very strongly spiniform, *not* unarmed.

As Mr. Faxon says, *Trachycarcinus* is very closely related to *Trichopeltarium*; in fact, the relation is so close as to make the separation of the two forms almost doubtful.

Family Portunidæ.

Benthochascon Hemingi, gen. et sp. n.

Closely related to *Bathynectes*.

Carapace subquadrilateral, its length about $\frac{2}{3}$ its breadth,

depressed, the regions faintly indicated by slight inequalities of level, its surface very finely granular.

The front, which is about a fourth the greatest breadth of the carapace, forms a thin laminar three-lobed projection. The antero-lateral borders, which are hardly arched and are not much more than half the length of the postero-lateral, are thin and are cut into four procurved teeth, of which the foremost is the orbital angle and the largest and the hindmost is spine-like and the longest. Postero-lateral borders slightly convergent; posterior border concave.

Eye-stalks short and thick, eyes large; orbits deep, two obsolescent sutures in the roof, a shallow notch in the outer wall, the inner angle of the floor almost as prominent as the outer frontal lobes.

Antennules folding transversely, their fossæ widely open to their respective orbits. The antennæ lie loosely in the orbital hiatus; the basal joint is short, slender, and movable, the second joint just reaches the turned-down edge of the front; the flagellum is considerably longer than the orbit.

Epistome well delimited from the palate. Though the expiratory channels are well-defined grooves there are no distinct palate-crests. The external maxillipeds fall far short of the anterior margin of the buccal cavern, leaving the expiratory canals permanently open.

Chelipeds massive, somewhat unequal, about two thirds as long again as the carapace, smooth; the hand, of which about half is formed by the fingers, forms rather more than half their entire length; the inner angle of the wrist is a large acute spine, and there is a spinule on the upper edge of the hand just behind the finger-joint.

Legs smooth; a notch and spiniform tooth at the far end of the upper border of all the meropodites. The first three pair are nearly twice the length of the carapace; the last pair are not much longer than the chelipeds and have the carpus shortened and the next two joints paddle-like and plumed.

Andaman Sea, 185 fathoms.

Family Carcinoplocidæ.

PILUMNOPLAX, Stimpson.

Pilumnoplax Sinclairi, sp. n.

Carapace subquadrilateral, much depressed, a little more than three quarters as broad as long, very finely frosted, perfectly bare, the regions fairly indicated.

Front horizontal, slightly prominent, square cut, grooved

but not distinctly notched in the middle, more than a third the greatest breadth of the carapace; its free edge is turned vertically downwards to form a narrow concave facet with raised margins.

The antero-lateral borders are not much more than half the length of the postero-lateral; they are thin and sharp and are cut into three teeth, of which the first is broad and somewhat emarginate, and the other two are acute. On the postero-lateral borders, just behind the junction with the antero-lateral, is a denticle.

The eyes are small but well-formed, and are freely movable. The orbits conceal the retracted eyes to dorsal view; their upper margin is fissured near the middle and the lower margin is slightly excavated just below the outer angle; the inner angle of the lower margin is not prominent, though dentiform.

The antennules fold transversely and their fossæ are freely open to their respective orbits.

The basal antennal joint is short and slender; the next joint reaches the front; the flagellum, which arises in the orbital hiatus, is about twice the length of the orbit.

The outer maxillipeds completely close the buccal cavern.

The chelipeds in the female (male unknown) are unequal, the large one being not quite twice as long as the carapace; their surface, under the lens, is finely frosted; the inner angle of the wrist is strongly pronounced and is capped by a pair of acute teeth.

Legs moderately stout, unarmed, smooth, almost hairless; the third pair, which are somewhat the longest, are about two and a half times the length of the carapace. The dactyli are compressed-styliform.

Colours in spirit French-grey, fingers much darker grey.

A single female specimen, from off the Travancore coast, 430 fathoms, has the carapace 13 millim. long and 16 millim. broad.

This species is closely related to *Pilumnoplax heterochir* (Studer), Miers, but is distinguished from it by the entire and more prominent front, by the absence of transverse markings on the carapace, by the longer legs, and by the smoothness of the chelipeds and legs.

From *Pilumnoplax abyssicola*, Miers, which it also closely resembles, it is distinguished by the smooth carapace (to the naked eye), by the turned-down milled edge of the front, by the spinule on the postero-lateral border, by the fissured upper margin of the orbit, and by the double spine of the inner angle of the wrist.

Family Rhizopidæ.

Camatopsis rubida, gen. et sp. n.

Nearest related to *Xenophthalmodes*.

Body and appendages covered with velvet.

Carapace deep, rudely semicircular, hardly broader than long, strongly convex fore-and-aft and declivous anteriorly, nearly flat from side to side; its only markings are two longitudinal grooves defining the epibranchial regions.

Front much less than a fourth the greatest breadth of the carapace, obscurely bilobed.

Orbits large, deep, the upper margin entire and cut in the anterior border of the carapace, the excision, however, being exactly compensated by the convex bulging of the anterior (true inner) borders of the eye-stalks; these are almost immovably fixed in the orbits. The eyes are reduced to a speck of pigment placed on the ventral surface of the tip of their stalks.

Antennule-fossæ widely open to their respective orbits, small and entirely filled by the basal antennule-joint to the complete exclusion of the large flagellum.

The small basal antenna-joint is wedged in between and beneath the eye-stalk and antennule, the second joint hardly reaches the front, the flagellum is considerably longer than the orbit.

The epistome is of good width. The buccal cavern is squarish and is almost entirely closed by the external maxillipeds. These have the merus as long as and markedly broader than the ischium, owing to the semilunar expansion of the outer border of the merus; the palp is jointed to the antero-internal angle of the merus. The efferent branchial canals cause an angular bulging in the pterygostomial regions.

The chelipeds are unequal in the male, the longer one being about $1\frac{1}{4}$ times the length of the carapace; they are unarmed and have their movements of abduction and extension somewhat cramped; the arm is short and trigonal, the wrist rather long and crooked; in the larger hand the fingers meet only at tip.

The last pair of legs are subdorsal and have the terminal joints strongly ciliated and the dactylus slightly compressed. The other legs have trigonal and elegantly plumose dactyli.

The abdomen of the male does not nearly fill the space between the last pair of legs; it is four-jointed.

Between the fourth and fifth segments of the sternum in the male a long narrow plate is intercalated.

Three males from the Andaman Sea, 194 fathoms.

Family Pinnoteridæ.

PINNOTERES, Latreille.

Pinnoterres abyssicola, sp. n., ♀.

Carapace as long as broad, circular, smooth; front rather prominent, about one fifth the greatest breadth of the carapace. The whole of the eyes and eye-stalks and almost the whole of the orbit are visible in a dorsal view. The eyes are well developed, but very pale. The dactylus of the external maxillipeds is styliform and is inserted at the end of the preceding joint. The lower border of the thumb is fringed with fine hairs. The legs are slender; the second and third pair are both about $1\frac{1}{2}$ times as long as the carapace, and have the dactylus slightly longer than it is in the other two pair.

A single female with eggs and with a carapace about 8 millim. in diameter was taken from a living individual of a large species of lamellibranch of the genus *Lima*, dredged off the coast of Travancore at a depth of 430 fathoms.

It is interesting to notice that this species is quite like any other *Pinnoterres*, and has apparently undergone no modification by exposure to bathybial conditions.

ANOMURA.

Family Paguridæ.

PYLOCHELES, Milne-Edwards.

Pylocheles Miersi, sp. n.

This species so closely resembles *Pylocheles Agassizii*, characterized by M. A. Milne-Edwards in Bull. Mus. Comp. Zool. vol. viii., 1880, and fully described and figured in Mem. Mus. Comp. Zool. vol. xxxiii., 1893, that from an examination of a single specimen we believed it to be the very same species.

However, ten specimens, dredged in the Andaman Sea at 185 fathoms, and including adults of both sexes, agree in exhibiting certain differences from the West-Indian species. Those differences are as follows:—

(1) The grooves of the carapace are without hairs and the arched line that bounds the gastric region anteriorly is very faint.

(2) The front border of the carapace is simply sinuous,

the teeth that occur in *P. Agassizii* being here rounded off instead of acute.

(3) The ophthalmic scales seem to be even less conspicuous, and the eyes seem to be even more reniform.

(4) The antennal spine and acicle are less sharply serrated.

(5) The high serrated carpal crest that overhangs the base of the hand is cut into two unequal lobes; the anterior surface of the hand, when denuded of its mat of hairs and bristles, is pitted rather than granular, and the edges of the hand are rather less acutely serrate.

(6) The first two pair of legs when fully extended reach beyond the tips of the fingers.

(7) The first abdominal tergum, in the male only, is rather more exposed; all the abdominal terga are almost hairless; and the posterior edge of the sixth tergum is excised.

In all other respects this species agrees exactly with the description and figures of *P. Agassizii* in the Memoir cited. Its habits, however, seem to be somewhat different, for whereas *P. Agassizii* was found burrowing in hard sand and in sponge, all our ten specimens were tightly impacted in the natural hollows of decaying driftwood that had sunk to the bottom—*e. g.* sticks of mangrove and bamboo.

Colours in life: upper surface of carapace and legs orange, lower surface white, eyes brown, eggs bright yellow. Spirit-specimens are cream-colour, with a metallic iridescence on the gastric region and on most of the abdominal terga.

Off east coast of North Andaman Island, 185 fathoms.

[I regret that in my list of Crustacea common to the "continental slopes" of the East and West Indian regions, published in Ann. & Mag. Nat. Hist. ser. 7, vol. ii., August 1898, pp. 140–141, this species appears as *Pylocheles Agassizii*.—A. A.]

Family Lithodidæ.

Paralomis, White, Bouvier.

Paralomis indica, p. n.

This is closely related to *P. verrucosa* (Dana), with a 'Challenger' duplicate of which species from Magellan Straits it has been compared. It differs chiefly from *P. verrucosa* in the following respects:—

The antero-lateral and lateral borders of the carapace are more irregularly and much more acutely spiny.

The abdomen, behind the second segment, has its dorsal surface somewhat creased, but not tuberculous.

The eyes are relatively much larger.

The movable antennal acicle has only two spines, one of which is small, on its outer border; the antennary flagella are nearly as long as the carapace.

The chelipeds and legs are relatively longer and slenderer; the wrist is longer and its inner angle does not form a foliaceous lobe.

Carapace piriform, convex, very slightly longer than broad; gastric, cardiac, and branchial regions well defined, the gastric and branchial tumid and prominent, the cardiac, though convex, a good deal sunken. The surface of the carapace, as of the second abdominal segment, is studded with vesiculous, pustulous, and conical tubercles of various sizes.

Rostrum very distinctly and evenly trifold and having a denticle on either side near the base.

Lateral margins of carapace, from the spiniform orbital angle to the posterior border, armed with spines of various sizes; posterior border armed with conical tubercles of uniform size.

Eye-stalks with a few denticles dorsally. Antennular peduncles smooth. Antennal peduncle with the first two joints spiniform at the outer angle, the flagellum about as long as the carapace.

The movable antennal acicle, which reaches slightly beyond the end of the antennal peduncle, ends very acutely; its outer edge bears a spinule and a large spine, its inner edge bears three small spines.

Chelipeds and legs spiny, especially on the dorsal surfaces. The right cheliped is distinctly stouter, and the right legs are distinctly longer, than the left. The legs, which are nearly a dactylus longer than the chelipeds and rather less massive than the left cheliped, are about $1\frac{2}{3}$ times the length of the carapace.

The second abdominal segment consists of a single plate dorsally, which is dimpled on either side of the middle line.

The abdomen of the male has a slight twist to the right and is nearly symmetrically constituted; in the female, although it is unsymmetrical, it is not much more twisted.

Four specimens, the largest of which has the carapace 39.5 millim. long and 37 millim. broad, were taken off the Travancore coast at 430 fathoms.

Colours in spirit pale milky orange-pink, eyes intensely black.

Paralomis investigatoris, sp. n.

This appears to be most nearly related to the *Paralomis aspera* of Faxon, from off the Pacific coast of Panama.

Carapace piriform, convex, slightly longer than broad; gastric, cardiac, and branchial regions well defined, tumid; the entire surface of the carapace, as of the second abdominal segment, is closely covered with equal-sized papilliform tubercles, each of which is encircled by a crown of small stiff hairs.

Rostrum very distinctly and evenly trifid, the middle spine with a few minute denticles at the proximal end of its ventral border; its sides and dorsal surface are spinate.

Lateral margins of carapace, from the spiniform orbital angle to the middle of the branchial regions, armed with sharp curved spines.

Eye-stalks dorsally spinuloso. Antennular peduncle smooth. Antennal peduncle with the first two joints spiniform at the outer angle and the third joint spiniform at the inner angle, the flagellum longer than the carapace.

The movable antennal acicle reaches nearly to the end of the peduncle and ends very acutely; its outer edge bears at least three large spines and its inner edge three small spines.

Chelipeds and legs thickly spiny, especially on the dorsal surfaces. The right cheliped is very slightly stouter than the left, which is not stouter than the legs; but the right legs are not longer than the left. The legs all end in a little black claw and are hardly half a dactylus longer than the chelipeds; they are about $1\frac{3}{4}$ times the length of the carapace.

The second abdominal segment bears a single dorsal plate, which is rather deeply dimpled on either side of the middle line.

The abdomen of the male is quite straight and practically symmetrical; in the female it is not quite symmetrical and is slightly twisted to the right.

Four specimens, the largest of which has the carapace 33 millim. long and 29.5 millim. broad, from off the Travancore coast, 430 fathoms.

Colours in spirit orange, eyes intensely black.

These are the first representatives of the genus *Paralomis* ever taken in Indian seas. A closely allied form—*Lithodes Agassizii*—was, however, taken in 1896 close to the spot where these two species of *Paralomis* were dredged last year.

Family Galatheidæ.

MUNIDA, Leach.

Munida comorina, sp. n.

Seems hardly to differ from the Caribbean *Munida caribbea*, A. M.-Edw. (which Faxon says is the same as *M. irasa*, A. M.-Edw.), having, like it, a long denticulated rostrum, no cardiac spine, and a smooth abdomen.

Dorsal surface of carapace transversely striated and bearing eight spinules, namely a pair behind each supraocular spine, one on either side behind and external to the first pair, and one on either side just beyond the bifurcation of the cervical groove; but all these spines need careful looking for with a lens.

Rostrum well over half the length of the rest of the carapace and about three times as long as the supraocular spines (and, like them, acicular), finely and obscurely denticulated in its distal half.

Abdomen perfectly smooth.

The two spines on the dilated portion of the antennular peduncle are long and slender. Eye-stalks barrel-shaped, eyes not reniform.

Chelipeds slender, twice the length of the fully extended body and rostrum and twice the length of the longest legs; distant spines along the inner aspects of the arm and wrist, and distant spinules along the inner border of the hand; fingers straight, but in some males the immobile finger is excavated and slightly bent at base for the reception of one or two enlarged teeth of the dactylus.

The fully extended body is only 15 millim. long.

Thirty specimens, from off the Travancore coast, 430 fath.

MUNIDOPSIS, Whiteaves.

Munidopsis trifida, Henderson.

Munidopsis trifida, Henderson, 'Challenger' Anomura, p. 156, pl. xvi. fig. 2.

We have already reported this species, which was originally discovered by the 'Challenger' in the fjords of western Patagonia, as also occurring in Indian seas; and Capt. Anderson has again this year dredged two fine specimens in the Andaman Sea at 498 fathoms.

One of these (an egg-laden female) agrees in every particular with Henderson's description and figure; the other,

which is a large male, has the hands enlarged and the immobile finger so bent and hollowed in its basal half that the movable finger meets it only near the tip, the movable finger being furnished with a serrated tubercle that occupies, without filling, the hollow of its fellow.

Munidopsis ? rosacea, A. Milne-Edwards.

Galathodes rosaceus, A. Milne-Edwards, Recueil de Figures de Crustacés, pl. xiii. fig. 1.

Two hundred and thirty-seven specimens from off the Travancore coast, 430 fathoms, are almost certainly identical with the 'Travailleur' species.

Our young female specimens, the size of the female figured by Milne-Edwards (which is stated to be enlarged three times), agree exactly with that figure; but in our adults the chelipeds are modified in a way that is not quite alike in any two out of over a hundred specimens.

In adults one or, more usually, both of the chelipeds are much, but very variably, thickened, especially in respect of the hand. Further, in certain adult males of no pre-eminent size the immobile finger of one or, more usually, both hands is bent and hollowed in its basal half, so that the fingers meet only near the tip, as in the adult male of the preceding species.

If this species be not the *Munidopsis (Galathodes) rosacea* of Milne-Edwards, at any rate it, like that species, has *Munidopsis (Galathodes) tridentata*, Eismark, for its nearest relative.

Munidopsis Hemingi, sp. n.

Near *M. ornata*, Faxon.

Carapace convex, broader behind than in front, covered with squamiform tubercles in no very conspicuous transverse arrangement, the regions well defined; a pair of tubercles on the anterior part of the gastric region are acute.

Rostrum short, simple, triangular, carinate; anterior border of carapace with a blunt tooth, antero-lateral border cut into three teeth, posterior border unarmed.

Abdomen unarmed, smooth, the second and third terga transversely bicarinate.

Eyes slightly movable, a tiny papilliform spinule at their inner angle.

Inner border of merus of external maxillipeds armed with two large spines.

Chelipeds in the female (male unknown) equal, as long as

the extended body without the telson and longer than the legs by their finger-length; their dorsal surfaces are covered with squamiform markings, the only spine is a small one near the distal end of the inner border of the wrist; the fingers are as long as the palm.

The first three pairs of legs have the dorsal surfaces of the metopodites and next two joints covered with squamiform markings; the dactyli are about half the length of their propodites.

Two specimens—the largest a female 25 millim. long—from off the Travancore coast, 430 fathoms.

The eggs are of enormous size, being nearly 2 millim. in major diameter after contraction in spirit.

The difference between *Munidopsis Hemingi* and *M. ornata*, Faxon, is very slight; in the latter species the edges of the rostrum are serrate and the chelipeds and legs are armed with some spines.

Munidopsis iridis, sp. n.

Extremely closely related to *M. margarita*, Faxon.

Carapace subquadrilateral, convex, its regions well delimited and tumid, its surface armed with numerous acute subsquamiform tubercles and symmetrically disposed spines, of which a pair on the anterior part of the gastric region and one in the middle of the cardiac region are slightly enlarged.

Rostrum short, simple, triangular, carinate, its edges indistinctly serrulate in their distal half; anterior border of carapace armed with an acute spine at the outer angle of the orbital notch; lateral borders armed with four acute spines, posterior border with several spines; a row of spinules above the postero-lateral border.

Second, third, and fourth abdominal terga transversely bicarinate, the first four or five carinae bearing symmetrically disposed spines; the corresponding pleurae are unicarinate, the anterior of them (second) having a single upstanding spine.

Eyes almost immovable; an inconspicuous spinule at their inner angle.

Three spines, two of which are large, on the inner border of the merus of the external maxillipeds.

Chelipeds markedly unequal in the male, very rarely slightly unequal in the female; in both sexes the dorsal surfaces of the arm and wrist are spiny, a few of the spines along the inner edge being enlarged, and the inner edge of the palm is spinulose.

In the adult male both chelipeds are vastly stouter than

the legs: the larger is about half as long again as the fully extended body and from a dactylus to half a dactylus longer than its fellow, and has the hand enlarged and the immovable finger so arched that the fingers meet only at tip; the smaller cheliped is very variable, sometimes it is hardly different from its fellow, but usually it is more slender, especially in respect of the hand, and usually the fingers meet throughout the greater part of their extent.

In the female the chelipeds are stouter, but not vastly stouter, than the legs, and are about as long as the fully extended body, and the fingers are nearly straight.

The legs are about as long as the body in its natural pose (with the abdomen bent) and are scabrous; the anterior border of the merus and carpus is spiny, the dactylus is nearly half the length of its propodite and has its posterior border almost imperceptibly serrulate.

The sternum and neighbouring joints of the legs are beautifully iridescent, as also sometimes is the dorsal surface of the bent-up portion of the abdomen.

Fifty-two specimens from off the Travancore coast, 430 fathoms.

An adult male has the body 26.5 millim. in extreme length and the larger cheliped 38 millim. long. An egg-laden female is 21 millim. long and its chelipeds measure the same.

Munidopsis Goodrigii, sp. n.

Differs from all known Indian species in having the eyes absolutely immovable, yet furnished with neither spine nor spinule. Its nearest relative is, perhaps, the Philippine species *M. Milleri*, Henderson.

Carapace subquadrangular, convex, slightly broader behind than in front, its regions well delimited, its posterior half deeply sculptured transversely.

Gastric region with some not very conspicuous squamiform sculpture and with a pair of large spines situated anteriorly; a spine on either side of, and a pair of spinules in the middle of, the anterior cardiac region.

Rostrum short, simple, rather slender, smooth. A large acute spine on the anterior margin of the carapace; lateral borders with two large spines and a spinule, posterior border smooth.

Abdomen smooth, the second tergum transversely bicarinate, the third transversely grooved.

Eyes quite immovable, without spine or spinule. Two

large spines on the inner edge of the merus of the external maxillipeds.

Chelipeds in the female (male unknown) slender, unequal, the larger one slightly longer, the smaller one very slightly shorter, than the fully extended body; two rows of spines on the arm, both series continued, but much less conspicuously, along the wrist, but not along the hand; the fingers meet throughout their length.

Legs long, the first three pairs being scarcely shorter than the fully extended body: their merus has a few spinules at the proximal end of its anterior border, and both its borders terminate acutely; their carpus is carinate and ends in a spine; their dactylus is more than half the length of the propodite and has its posterior border spinulate.

A single female from off the Travancore coast, 430 fathoms.

The length of the carapace is 21.5 millim., of the larger cheliped 24 millim., of the smaller cheliped 21 millim.

Munidopsis Moresbyi, sp. n.

Carapace convex, broader behind than in front, covered as far as the tip of the rostrum with transverse, squamiform, ciliated sculpture, spineless, the regions inconspicuous.

Rostrum of moderate length, simple, triangular, dorsally carinate. A blunt tooth on the anterior border of the carapace; lateral borders cut into two blunt lobes exclusive of the subacute antero-lateral angle, but these lobes may be almost indistinguishable; posterior border smooth.

Abdomen unarmed, the second to the fifth terga transversely grooved; the fifth and sixth terga, the telson and the outer half of the blades of the swimmeret, and the margins of the pleuræ with a fine, rather irregular, squamiform sculpturing.

Eyes freely movable, spineless, more or less retractile beneath the rostrum.

Two very inconspicuous teeth on the inner edge of the merus of the external maxillipeds.

Chelipeds and legs covered with ciliated squamiform sculpturing, unarmed.

Chelipeds moderately stout, equal in both sexes, as long as the body in its natural pose (with the abdomen flexed), not half a dactylus longer than the legs; palm and fingers as long as the three preceding joints combined, the fingers slightly longer than the palm.

The dactyli of the legs are about half the length of the propodites and have the posterior border serrated.

A male and a female from off the Travancore coast, 430 fathoms.

In the male the carapace is 38 millim. long and the chelipeds 27 millim.

Colour in life pink.

This species is not very closely related to any of those with which we are acquainted. In the system of MM. Milne-Edwards and Bouvier (Ann. Sci. Nat. Zool. sér. 8, vol. xvi. 1894) it would be placed alongside *M. ornata*, Faxon, but it is very different from that species. It well illustrates the difficulties that attend the splitting-up of *Munidopsis* into subordinate genera, for it might almost equally well be placed with *Elasmonotus* or with *Orophorhynchus*, although it is unlike the typical species of those genera.

PTYCHOGASTER, A. Milne-Edwards.

[*Ptychogaster*, sp.

A single very small specimen from off the Maldives, 459 fathoms, is so closely similar to *P. Milne-Edwardsi*, Henderson, from off the Patagonian coast, that we do not feel justified in giving it a distinctive name, but await further material.]

Ptychogaster Hendersoni, sp. n.

Carapace (including rostrum) equal in length to the first six fully extended abdominal terga, covered with spinules and spines, in which a definite serial arrangement of the larger spines is hardly manifest.

All the abdominal terga (telson excepted) and pleuræ bear spines: the first tergum has a transverse spiny carina continuous with a similar carina on the anterior edge of the second pleuræ; the second has two such carinæ; the third has a longitudinal row of spines at the junction with either pleura; the fourth and fifth have two transverse series of spines, besides an occasional spine on their posterior edge; the sixth has numerous spines, including three conspicuous transverse series.

First segment of the telson not much more than half the length of, and slightly broader than, the second.

External maxillipeds unarmed, except for the fine teeth along the inner edge of the ischium, hairy along inner edge, especially at distal end.

Chelipeds and legs long, slender, and spiny; in the female (male unknown) the chelipeds are more than $2\frac{3}{4}$ times the

length of the fully extended body and nearly half as long again as the legs; the first two pair of legs are nearly of one length, but the third pair are the longest by nearly a dactylus, owing to the elongation of their propodite, which is nearly five times as long as the dactylus.

A female from off the Travancore coast, 430 fathoms, is 30 millim. in extreme length when fully extended, and has chelipeds 86 millim. long and third pair of legs 55 millim. long.

Colour salmon-pink, eyes deeply pigmented.

Ptychogaster investigatoris, sp. n.

Carapace short, its length (including the rostrum, which is slightly more than a fourth the total length of the carapace) is only equal to that of the first five and a half fully extended abdominal terga; its surface is everywhere studded with spinules and spines, the largest of which show a tolerably plain arrangement in four longitudinal series.

The only abdominal tergum (besides the telson) that is quite free from spines is the third: the first tergum has a transverse spiny carina continuous with a similar carina on the edge of either pleura of the second segment; the second has a transverse raised row of four large spines, besides several teeth; both the fourth and fifth are separated from their pleuræ on either side by a longitudinal row of two or three spines or serrations; the sixth is covered with retrorse spinules and spines, including three conspicuous transverse series, of which the last far overhang the telson.

The first segment of the telson is hardly perceptibly longer, and slightly narrower, than the second; the surface of both bears some inconspicuous capillary spinelets or bristles.

The pleuræ of the third and fourth abdominal somites are devoid of spines.

The external maxillipeds are unarmed, except for the ischial serrations, and are very hairy in their distal half.

Chelipeds and legs long, slender, and spiny; the chelipeds in the female (male unknown) are about $2\frac{3}{4}$ times the length of the fully extended body and half as long again as the legs; the racquet-like form of the hand, due to the bowing of the basal half of the fingers, is more than ordinarily conspicuous.

Of the first three pair of legs the first is slightly the longest and the second slightly the shortest; the dactyli of all are hardly more than a quarter the length of the propodites.

A female from the Andaman Sea, 405 fathoms, is

55 millim. in length when fully extended, and has chelipeds 132 millim. and first legs 91 millim. long.

The eyes are large and rather pale.

UROPTYCHUS, Henderson.

Uroptychus, sp.

A large egg-laden female, the body of which when fully extended measures 36·5 millim., can only be distinguished from the Australasian *U. australis*, Henderson, by having the under and inner surfaces of the arm and wrist studded with vesiculous granules. It is probably a variety of *U. australis*.

Uroptychus bacillimanus, sp. n.

Nearest to *U. gracilimanus*, Henderson, from which it seems to differ only in having the carapace pitted and the posterior border of the propodites of the legs unarmed, and to the Atlantic *U. rubrovittatus*, A. M.-Edw., from which it differs in having slender chelipeds and also the posterior border of the propodites of the legs unarmed.

Carapace unarmed, except for a tiny spinule at either antero-lateral angle and another at the outer angle of either orbital notch; its surface covered with a fine squamiform pitting, its lateral borders with a regular squamiform crenulation.

Rostrum triangular, simple, acute, more than a third of its length projecting beyond the eyes.

Abdomen smooth; the third to sixth pleuræ rounded.

Eyes small, their major diameter less than a fifth the length of the rostrum, brown in colour.

Antennal acicle acutely triangular, reaching about two thirds the distance along the terminal joint of the antennal peduncle.

Chelipeds in both sexes about twice the length of the fully extended body, very slender in the male, still more slender in the female, perfectly smooth, but bearing (as do also the legs) some curiously long and delicate silky hairs; the hand is longer and slightly broader than the wrist, the fingers are considerably less than half the length of the palm.

Legs slender, less than half the length of the chelipeds; a few spinules on the posterior border of the dactyli, but only a single one (situated terminally) on the posterior border of the propodites.

A young male and female from off the Travancore coast, 480 fathoms, and an egg-laden female from off Ceylon,

320 fathoms. The last when fully extended measures 29 millim. from tip of rostrum to end of telson.

This species is readily distinguished from *Uroptychus nitidus*, of which undoubted specimens have been dredged by the 'Investigator,' in the form of the chelipeds, the smaller eyes, and the pitted carapace.

Uroptychus fusimanus, sp. n.

Dorsal surface of carapace studded with numerous spines in more or less distinct rows, the well-defined cariniform lateral borders acutely spinate. Abdomen perfectly smooth.

Carapace (without rostrum) slightly longer than broad; cervical suture very well defined; rostrum acutely triangular, simple, the frontal margin on either side of it deeply concave for the eye.

Antennal acicle large, reaching as far as the tip of the peduncle.

Chelipeds in both sexes equal, about $1\frac{3}{4}$ times the length of the fully extended body, much stouter and rather more than one third of their extent longer than the legs, sub-cylindrical as far as the compressed and broadened hands; along the upper and inner surfaces of the arm and wrist are longitudinal rows of spines, those in at least two rows being conspicuously enlarged and sharply raised; hands smooth, broadened, the edges of the palm almost cristiform.

First three pair of legs slender, smooth, the meropodites somewhat dilated, the third pair about a dactylus shorter than the other two; the dactyli are less than a third the length of their propodites, and they alone have the posterior border finely toothed in the distal two thirds.

Seven specimens (one an egg-laden female), from off the Travancore coast, 430 fathoms.

The fully extended body of the largest female measures 31 millim. and the chelipeds 53 millim.; that of the largest male measures 27 millim. and the chelipeds 42 millim.

Uroptychus cavirostris, sp. n.

Dorsal surface of carapace perfectly smooth; two sharp spines (including the one at the antero-lateral angle) on either lateral border. Abdomen perfectly smooth.

Carapace (without rostrum) longer than broad; cervical groove not well defined, branchial regions well defined by swelling. Rostrum simple, acute, broadly triangular, dorsally concave. A minute spinule at the outer angle of the orbit.

Antennal acicle not reaching to the tip of the peduncle. Eyes nearly reaching tip of rostrum.

Chelipeds in the female (male unknown) not much less than twice the length of the fully extended body, much stouter than, and more than twice as long as, the legs; smooth, except for a hook-like spine on the ischium, a few squamiform granules on the under surface of the base of the merus, and a few inconspicuous denticles on the terminal borders of the merus and carpus; they gradually broaden to the palm, which is the broadest joint and is more than twice the length of the fingers; the tips of the fingers are hidden by some very long silky hairs.

The first three pair of legs are short, slender, and smooth, except for strong serrations on the posterior border of the curved dactylus and of the propodite. The third pair are very slightly the longest.

A single egg-laden female from off the east coast of North Andaman Island, 75-60 fathoms.

The length of the fully extended body is 17 millim., of the chelipeds 32 millim., of the longest (third) pair of legs 13.5 millim.

II.—On the British Pandalidæ. By W. T. CALMAN, B.Sc., University College, Dundee.

[Plates I.—IV.]

IN a paper "On Deep-sea Crustacea from the South-west of Ireland" * I lately recorded the occurrence for the first time in British waters of two species of *Pandalus*, referred to the *P. propinquus* and *P. leptorhynchus* of G. O. Sars, in addition to the two already known to occur in our seas—*P. Montagu*, Leach, and *P. brevis*, Rathke. In the present paper brief descriptions and figures are given of the more important diagnostic characters of these four species, some of which characters have not hitherto been pointed out.

In his account of the Crustacea dredged by the 'Caudan' in the Bay of Biscay M. Maurice Caullery has recently described † a species of *Pandalus* differing from all the members of the family hitherto described in possessing on

* Trans. Roy. Irish Acad. xxxi. pt. 1, 1896; see p. 6.

† "Résultats Scient. de la Campagne du 'Caudan' dans le Golfe de Gascogne, 1895: Crustacés Schizopodes et Décapodes," par M. Caullery, 'Annales de l'Université de Lyon,' 1896, pp. 377-381.

the first pair of peræopods a very minute chela in place of the styliform termination usually ascribed to this appendage. In calling attention to this character M. Caullery says:—"En comparant à la fig. 12 certains des uns des auteurs, on se demande si cette pince n'a pas échappé quelquefois aux observateurs dans d'autres formes, et il serait désirable puisque maintenant son existence est reconnue dans un cas, de la rechercher dans les autres Pandalidæ." So far as concerns the British species, at any rate, I am able to confirm this suggestion of M. Caullery. A microscopic but perfectly formed chela is found on the first peræopods of all of them, including the familiar type of the genus, *P. Montagu* (Pl. I. fig. 1, e), which for more than three quarters of a century has been described as having the first legs "simple." Even under the microscope the chelate termination may easily escape notice, on account of the brush of setæ among which it is partly hidden. Closer examination, however, reveals the minute dactylus, separated from the propodus by a distinct articulation and, as it is easy to convince oneself by touching with a needle, freely movable. I am unable to say whether muscles for opening and shutting the chela are present. Both the fingers are slightly curved, and a tuft of long curved setæ springs from the inner margin of each. The fingers are from one-twelfth to one-tenth of the whole length of the propodus in adult specimens of *P. Montagu*, and proportionately a little longer in young individuals. No differences worthy of note are observable in the other British species.

Further research is required to show whether the subgenus *Dichelopandalus* which M. Caullery has based upon this character may not be co-extensive with the genus *Pandalus* itself. The collection of Crustacea in the Museum of University College, Dundee, contains only three species of the genus, in addition to those already named; but all of them, viz. *P. borealis*, Krøyer, *P. leptocerus*, S. Sm., and *P. Daner*, Stps., agree in this respect with the type species. As regards the other genera of the family, M. Caullery has shown (*l. c.* p. 379) that no chela is formed in *Plesionika martia*, A. M.-E., though a minute dactylus appears to be present. I find, on the other hand, that the first peræopod of *Heterocarpus gibbosus*, Sp. Bate, carries a chela similar to that of *Pandalus*. I have below given reasons for believing that M. Caullery's *Dichelopandalus Bonnier* is identical with the *P. leptorhynchus* of Sars and that the former specific name must be retained for it.

As regards the generic position of the forms here discussed,

P. propinquus and *P. Bonnieri* agree with *P. Montagu* in the essential characters of the genus *Pandalus* as defined by Spence Bate *. That author, indeed, includes amongst these characters the absence of an exopod from the third maxilliped; but as he proceeds to describe this appendage as "carrying a small thread-like cephalopod" or exopod in *P. fulcipis* †, it is plain that little importance can be attached to this point. The branchial formula given by Spence Bate for this genus is in error in attributing only one arthrobranchia to the third maxilliped. In our species the formula agrees with that given by Smith ‡ and by Boas §, in which two arthrobranchiæ correspond to that appendage.

The fourth British species—*P. brevirostris* of Rathke—has been referred by Spence Bate || to his genus *Nothocaris*, with which it agrees in the possession of fixed "teeth" as well as articulated "spines" in the dorsal armature of the carapace and rostrum. It differs from that genus, however, in the fact that the teeth are confined to the rostrum and do not extend to the dorsal crest, which is furnished with spinules only, while the "stylocerite" or basal scale of the antennule is rounded as in *Pandalus* ¶, not produced and pointed as in *Nothocaris*. I find, moreover, that the branchial system of this species differs from that of *Nothocaris*, and, indeed, of all the Pandalidæ described by Spence Bate, in the absence of arthrobranchiæ from all the peræopods.

While certain of the existing genera of Pandalidæ appear to be by no means satisfactorily defined and a revision of the whole group is much required, the very aberrant branchial formula of *P. brevirostris* may perhaps be held to justify the creation of a new genus, for which I propose the name *Pandalina*, for the reception of that species.

Genus PANDALUS, Leach.

Carapace without lateral crests. Dorsal crest and upper edge of rostrum armed with movable spinules only. Basal

* Chall. Rep. Macrura, pp. 625 and 665.

† *Op. cit.* p. 669.

‡ Bull. Mus. Comp. Zool. x. 1882-83, p. 66.

§ "Decap. Slægtskabsforhold," Vidensk. Selsk. Skr. (6) Naturv. og Math. Afd. I. 2, p. 162.

|| Chall. Rep. Macrura, p. 653.

¶ In Spence Bate's definition of the genus *Pandalus* the "stylocerite" is said to be rounded and "but half the length of the joint which carries it." Nevertheless he figures this structure in his *P. magnoculus* (*op. cit.* pl. cxv. fig. 1 b) as pointed and about two thirds the length of the joint from which it springs.

lobe of antennules broad and rounded. Posterior lobe of scaphognathite acutely pointed (Pl. II. fig. 1, c). Second pair of peræopods unequal, the carpus of the longer multi-articulate. Branchial formula:—

	Mxpd. ⁴	Mxpd. ³	Per. ¹	Per. ²	Per. ³	Per. ⁴	Per.
Pleurobranchiæ ..	..	..	1	1	1	1	1
Arthrobranchiæ ..	..	2	1	1	1	1	..
Podobranchiæ ..	1+ep.	ep.	ep.	ep.	ep.	ep.	..

Type species *Pandalus Montagu*, Leach.

Pandalus Montagu, Leach. (Pls. I.–IV. fig. 1.)

Pandalus Montagu, Leach, Edinburgh Encyclopædia, vii. p. 492 (1814).

Pandalus annulicornis, Leach, Malacostraca Podophth. Britannicæ, pl. xl. (1815); Krøyer, Voyages en Scandinavie, Crustacés, Atlas, pl. vi. fig. 3, a–c (1846); Bell, Hist. Brit. Stalk-eyed Crustacea, p. 207 (1853).

Pandalus Montagu, White, Cat. Brit. Crust. Brit. Mus. p. 41 (1850).

Description.—The length of the *rostrum* (Pl. I. fig. 1, a) referred to that of the carapace as unity varies in our specimens from 1.2 to 1.5*. It is curved strongly upwards, rather deep, and bifid at the tip. The number of spines on its upper edge, including those on the dorsal crest of the carapace, is ten or eleven (in one specimen twelve); of these four are placed on the carapace behind the orbital notch, or in some cases the fifth spine is just over the posterior margin of the notch. In only one case out of about twenty examined were there only three spines behind the orbit. Below, the edge of the rostrum is cut into 5 or 6 strong teeth.

The flagella of the *antennules* are approximately equal in length to the carapace and reach to the tip of the rostrum or only a little way beyond. The basal lobe is fringed with setæ on its anterior edge.

The *antennal scale* (Pl. II. fig. 1, b) has its outer edge straight or slightly convex, terminating in a spine which projects beyond the rounded tip of the scale. The width at the tip is more than one third of the greatest width at about one quarter the length from the base. It is to be noted that

* The length of the carapace is taken from the posterior edge in the mid-dorsal line to the back of the orbital notch, while the rostrum is measured forward from the last-named point.

in some very small individuals of this species (about 25 millim. long) the outer edge of the antennal scale was found to be slightly concave, as in the adult *P. propinquus*.

The *third maxillipeds* (Pl. II. fig. 1, *d*) have no exopod and the terminal joint is about $1\frac{1}{2}$ the length of the preceding.

Of the *second peræopods* (Pl. III. fig. 1, *f*) that on the *right* side reaches a little beyond the tip of the antennal scale when extended forwards. The carpus is divided into about 20 segments by annulations which are most distinct distally. The merus shows about four indistinct annulations at its distal end. On the *left* side the second leg extends beyond the tip of the rostrum for about $\frac{1}{2}$ to $\frac{1}{2}$ the length of the carpus.

The remaining peræopods are rather stout and have the dactyl, especially in the last pair (Pl. IV. fig. 1, *g*), short and thick. The third legs reach a little beyond the tip of the antennal scale, while the last pair hardly reach beyond the middle of the scale when extended forwards.

In the *first pleopods* of the male the endopod (Pl. IV. fig. 1, *h*) is produced distally and internally into a process tapering to a point and armed on its inner edge with a group of *retinacula*. Externally at the base of this process the outer border of the endopodite forms a rounded shoulder or external lobe, which in this species is not further produced. The internal margin of the endopod is armed in its distal part with a number of stout spines. While the form of appendage just described, which agrees with the figure given by Krøyer (*l. c.* fig. 3, *d*), appears to be the typical one for this species, I have met with three specimens (collected together in one locality, Easthaven) in which the shape of the endopod is different (Pl. IV. fig. 1, *h'*). The inner process is club-shaped, narrow at the base and swollen at the tip, and it projects somewhat inwards from the inner edge of the endopod. The outer lobe is narrower and more prominent than in the typical form, though still much shorter than the internal process, and the spines on the inner edge of the endopodite are very short. Both the inner and outer borders of the endopod are more convex, or, in other words, the endopod as a whole is ovate or lanceolate rather than oblong. The specimens showing this form of appendage are of different sizes and appear to present no specific differences from typical specimens of *P. Montagu*. It is possible that the characters mentioned may be due to immaturity, but unfortunately the material at my disposal is not sufficient to elucidate this point. I have also examined a specimen, apparently full-grown, in which the first pleopod on the right side had the endopod of the

form characteristic of the female, while that on the left side resembled the second form of the male appendage described above, save that the internal process was rather small and irregularly formed. The specimen in other respects was well developed, and no trace could be detected of Bopyrid or other parasites. In the second pleopods of the male the *appendix masculina* is about half the length of the *appendix interna*.

The *telson* bears on its upper surface five or six pairs of spinules in front of the large spines at the corners of the truncated tip.

Size.—Our largest specimen is about 95 millim. in length from the tip of the rostrum to the end of the telson.

Occurrence.—This species appears to be common all round our coast. It frequently occurs in tide-pools, and we have specimens from 30–70 fathoms in Loch Fyne. Records of its occurrence at greater depths in British waters are open to suspicion of possible confusion with one or other of the two species next to be described.

Pandalus propinquus, G. O. Sars. (Pls. I.–IV. fig. 2.)

Pandalus propinquus, G. O. Sars, "Nye Dybvandscrustaceer fra Lofoten," Vidensk. Selsk. Forh. Christiania, 1860, p. 148; id. "Undersøgelser over Hordangerfjordens Fauna," Vidensk. Selsk. Forh. Christiania, 1871, p. 259; S. J. Smith, Proc. Nat. Mus. Washington, iii. p. 437 (1881); id. Bull. Mus. Comp. Zool. Harvard, x. p. 58 (1882–83); G. O. Sars, "Oversigt af Norges Crustaceer," Vidensk. Selsk. Forh. Christiania, 1882, no. 18, p. 47; A. Milne-Edwards, Recueil de Figures de Crustacés nouveaux ou peu connus (1883).

The *rostrum* (Pl. I. fig. 2, *a*) is similar to that of *P. Montagu* and of about the same relative length, but rather deeper and more strongly curved upwards. Above there are 8–9 spines, of which three are on the carapace. The lower edge of the rostrum is cut into 5–7 teeth, which are in some specimens much more slender and turned forwards than in *P. Montagu*.

The flagella of the *antennules* reach well beyond the tip of the rostrum, the internal flagella being in the specimens examined from once and a half to twice the length of the carapace. The basal lobe is free from setæ on its anterior edge.

The shape of the *antennal scale* (Pl. II. fig. 2, *b*) is very characteristic, being much narrowed anteriorly, where the width is only about one fourth of the greatest width of the scale a little above the base. The tip is transversely truncated or slopes a little backwards from the prominent tooth on

its outer side. The external edge is distinctly concave, the whole scale curving slightly outwards from the base.

The *third maxillipeds* agree closely with those of *P. Montagu*.

The *second pereopod* on the *right* side (Pl. III. fig. 2, *f*) is shorter and stouter than the corresponding appendage of *P. Montagu*, only reaching to or falling a little short of the tip of the antennal scale. The carpus is divided by four articulations into five segments, of which the first occupies about one half the length of the carpus, while the next three are subequal and together equal the length of the fifth segment. The chela is much stronger than in *P. Montagu*. On the *left* side the second leg is shorter than is usual in *P. Montagu*, just reaching to the tip of the rostrum.

The remaining thoracic legs, on the other hand, are longer and more slender than in *P. Montagu*, those of the third pair reaching considerably, and those of the last pair a little, beyond the tip of the antennal scale. The dactyl is a little longer and more slender than in the type species (Pl. IV. fig. 2, *g*).

In the *first pleopods* of the male the endopod (Pl. IV. fig. 2, *h*) differs from that of *P. Montagu* in having the pointed inner process very short, while the rounded outer lobe is more prominent than in that species, so that both reach about the same level. In the second pleopods of the male the *appendix masculina* slightly exceeds the *appendix interna* in length.

The *telson* bears on its upper surface five pairs of spinules in all the specimens examined.

The three British specimens of this form which I have seen agree in all essential points with Sars' original description and with a very fine female specimen from Norway presented to the Museum of University College by Prof. Sars. Two specimens from the American coast presented by the Smithsonian Institution differ in the larger number of teeth on the rostrum, $\frac{11}{7}$ in the one case and $\frac{13}{9}$ in the other; both, however, have, as usual, three spines on the carapace. The American specimen figured by A. Milne-Edwards (*l. c.*) has $\frac{11}{9}$ rostral teeth, and of these four are on the carapace, as is usual in *P. Montagu*. Smith (*l. c.* 1881) records an abnormal specimen in which the usual characters and proportions of the right and left chelipeds were reversed*.

* Smith also found an example of the same abnormality in *P. leptocerus*. Boas ('Decapodernes Skjætskabsforhold,' 1880, p. 35 (57)) states that in *P. borealis* the longer chela is sometimes the right, sometimes the left.

Size.—Our largest specimen is about 73 millim. total length. Sars (*l. c.* 1871) states that full-grown individuals may exceed 100 millim., and the specimen sent us by him is nearly of that length. Smith records a specimen over 110 millim. in length.

Occurrence.—I have seen only three specimens from British localities—a male and a female from Lower Loch Fyne, depth not recorded, and a female from 40 fathoms in Loch Long. Hitherto the species has only been recorded from Norwegian and New England waters, at depths of 80–300 fathoms in the former (Sars) and 116–524 fathoms in the latter (Smith).

Pandalus Bonnier, Caullery. (Pls. I.–IV. fig. 3.)

Pandalus leptorhynchus, G. O. Sars, "Oversigt af Norges Crustaceer," Vidensk. Selsk. Forh. Christiania, 1882, no. 18, p. 47, pl. i. figs. 8–10.

Pandalus (Dichelopandalus) Bonnier, Caullery, Rés. Scient. d. l. Campagne du 'Caudan,' Crustacés Schizopodes et Décapodes, Ann. Univ. Lyon, 1896, p. 379, pl. xv. figs. 7–15.

Non *Pandalus leptorhynchus*, Kinahan, Nat. Hist. Rev. v. 1858, Proc. Soc. p. 40.

Non *Pandalus leptorhynchus*, Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 38.

The *rostrum* (Pl. I. fig. 3, *a*) is more slender and, as a rule, more nearly horizontal than in *P. Montagu*, curving downwards a little way from the base and then rising gently towards the tip, which is very little above the produced dorsal line of the carapace. In a few specimens, however, the upward curvature is much more strongly marked. The number of spines above varies from 8 to 11, the most common number being 9, and of these *three* are behind the orbit in all the specimens examined. The number of teeth on the lower edge varies from 6 to 8.

The inner flagella of the *antennules* measure from about once and a half to twice the length of the carapace and extend far beyond the tip of the rostrum. The basal lobe is without setæ on its anterior edge.

The *scale* of the *antenna* (Pl. II. fig. 3, *b*) is similar in shape to that of *P. Montagu*, but the terminal spine is less prominent, not projecting beyond the tip of the scale.

The *third maxilliped* (Pl. II. fig. 3, *d*) carries an exopod reaching to about one third of the length of the ischial joint. In other respects the appendage agrees closely with that of *P. Montagu*.

The *second pereopod* (Pl. III. fig. 3, *f*) on the *right* side resembles that of *P. propinquus*. As in that species, the

carpus is divided into five segments *. When extended forwards the limb reaches a little beyond the middle of the antennal scale. On the *left* side the second leg reaches to, or only a little beyond, the tip of the rostrum. The remaining legs just reach to, or fall a little short of, the tip of the antennal scale. They are much more slender than in either of the species above described, and the very long and slender dactylus affords a conspicuous character by which the species may be readily recognized (Pl. IV. fig. 3, g).

In the *first pleopods* of the male the endopod (Pl. IV. fig. 3, h) has almost exactly the same form as the corresponding appendage of *P. propinquus*, the outer lobe being rounded and equalling, or even slightly surpassing, the internal process in length. In the second pleopods of the male the *appendix masculina* is slightly longer than the *appendix interna*.

The *telson* has in most cases seven pairs of spines on its upper surface, but in one or two cases a larger number (8-9) is present, not always symmetrically placed.

Prof. Sars' short description of the specimens referred by him (with an expression of doubt) to the *P. leptorhynchus* of Kinahan and the figures which he gives of the rostrum and the second pair of legs show close agreement with the specimens before me. No mention is made of the presence of an exopod on the third maxillipeds; but in reply to an inquiry on this point, Prof. Sars very courteously informed me that a re-examination of his specimens showed them to be possessed of this appendage, so that little doubt can remain as to the identity of the species. On the other hand, I do not think that Sars' hesitating reference of this form to the *P. leptorhynchus* of Kinahan can be sustained. Kinahan describes his species as having the rostrum shorter than in *P. Montagu*, "rounded instead of compressed at the sides, wanting the membranous dilatation on the under edge outside of the eye." There are five spines on the carapace, separated by an interval from the six spines on the rostrum, which is armed below with four "very minute" teeth. The figures given are somewhat crude and certainly do not suggest any close resemblance to the present species. The presence of *five*

* In one specimen (out of eleven examined) the carpus shows indistinct annulations on the proximal side of the four normal articulations, and traces of annulations are discernible even on the merus. The whole limb is rather longer and more slender than usual. S. J. Smith has recorded a similar variation in his *P. leptocerus* (Proc. U.S. Nat. Mus. iii. p. 438, 1881). Out of several hundred specimens examined by him only six were abnormal in the segmentation of the carpus, and of these one had "the right carpus multiarticulate throughout and composed of about eighteen segments, nearly as in *P. Montagu*."

spines on the carapace is a character not found in any of our specimens, while the small size (about 19 millim.) and littoral habitat ("in a small sand-pool in the *Zostera*-bank at Sandycove, Kingston") help to strengthen the probability that Kinahan had before him only a young and possibly somewhat aberrant specimen of *P. Montagu*.*

The species described by Caullery (l. c.) as *Pandalus* (*Dichelopandalus*) *Bonnieri* appears to differ in no essential point from the present form. By the great kindness of M. Caullery I have been permitted to examine two of the type specimens. Both unfortunately were very imperfect (as were all the specimens obtained), but, so far as could be seen, presented no differences from our specimens save in their smaller size. As Caullery's figures show, they agree in the characteristic points of the exopod on the third maxillipeds, the long and slender dactyli of the ambulatory legs, and the presence of only three spinules on the carapace behind the rostrum. From the description we also gather that the carpus of the second leg is five-jointed. Since I believe that Kinahan's name cannot properly be applied to the present species, that used by Caullery will take its place; and as his subgenus *Dichelopandalus* may be left in abeyance till it is shown not to be synonymous with the genus itself, the name for the species defined above will be *Pandalus Bonnieri*, Caullery.

Size.—The total length of our largest specimen is about 110 millim.

Occurrence.—About a dozen specimens are in our collection from various localities in Loch Fyne and Loch Long from depths of 40–105 fathoms. The only other locality within the British area from which it has yet been recorded is off the south-west coast of Ireland, 214 fathoms (Calman, Trans. Roy. Irish Acad. xxxi. pt. 1, 1896, p. 6). I have also examined specimens taken in 120 fathoms off Rockall (*tom. cit.* p. 77). Prof. Sars records it from Norway at depths of 60–150 fathoms, and the 'Caudan' dredged it in the Bay of Biscay at from 180 to 1200 metres. It is probable that this species as well as *P. propinquus* has been frequently confounded with the common *P. Montagu*. Prof. Henderson, in his "Decapod and Schizopod Crustacea of the Firth of Clyde" (Trans. Nat. Hist. Soc. Glasgow, 1886, p. 36, sep. copy), says of *P. annulicornis* (= *Montagu*), "Many examples

* The name *leptorhynchus* was afterwards independently used by Stimpson for an Australian species of *Pandalus* very different from any of the forms here discussed (Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 38).

from deep water, especially those taken in Loch Fyne, have the beautiful red tinge so characteristic of deep-sea Crustacea," and he gives the size of large specimens as $4\frac{1}{2}$ inches. It is not unlikely that these large red-coloured specimens from deep water belonged to the present species. One of our specimens, after several years' preservation in glycerine, still shows traces of a brilliant red coloration, especially on the anterior part of the carapace and on the legs.

The *P. leptocerus* of Smith (Proc. U.S. Nat. Mus. iii. p. 437, 1880; Bull. Mus. Comp. Zool. x. p. 58, 1882-83; A. Milne-Edwards, 'Recueil de Fig. de Crustacés nouveaux ou peu connus,' 1883) is very closely related to the present species, from which, however, it is at once distinguished by the minutely scabious surface of the body. The *Pandalus falcipes* of Spence Bate (Rep. Chall. Macrura, p. 698, pl. cxv. fig. 2) is, perhaps, identical with Smith's species.

Genus PANDALINA, nov.

Carapace without lateral crests. Upper edge of rostrum armed with fixed teeth as well as movable spinules. Basal lobe of antennules broad and rounded. Scaphognathite with posterior lobe truncated (Pl. II. fig. 4, c). Second pair of peræopods unequal, carpus of the longer multiarticulate. Branchial formula:—

	Mxp ^d . ²	Mxp ^d . ³	Per. ¹	Per. ²	Per. ³	Per. ⁴	Per. ⁵
Pleurobranchiæ . .	..	..	1	1	1	1	1
Arthrobranchiæ	..	2	..	..	..	..	..
Podobranchiæ ..	1+ep.	ep	ep.	ep.	ep.	ep.	..

Type species *Pandalina brevirostris* (Rathke).

Pandalina brevirostris (Rathke). (Pls. I.-IV. fig. 4.)

Pandalus brevirostris, Rathke, Beitr. z. Fauna Norwegens, Acta Ac. Leop. xx. p. 17 (1843).

Hippolyte Thompsoni, Bell, Hist. British Stalk-eyed Crustacea, p. 290.

Pandalus Jeffreysi, Spence Bate, Nat. Hist. Rev. vi. 1859, Proc. Soc. p. 100.

Pandalus Thompsoni, Norman, Ann. & Mag. Nat. Hist. (3) viii. 1861, p. 279, pl. xiv. figs. 3-9.

Pandalus Rathkii, Heller, Sitzungsber. d. Wien. Akad. Wiss. xlv. 1863, p. 441, pl. iii. fig. 31.

Pandalus brevirostris, Heller, Crust. südl. Europa, 1863. p. 247, pl. viii. fig. 9; A. Milne-Edwards, Recueil de Fig. de Crustacés nouveaux ou peu connus (1883)*.

Rostrum (Pl. I. fig. 4, *a*) about half the length of the carapace, straight, pointed at the tip. Above there are 7 or 8 spines (the latter number is more common), of which 4 or 5 are on the carapace. Two (or rarely three) of the most anterior are not separated from the rostrum by articulation. Below, the rostrum bears 2, 3, or rarely 4 minute teeth.

The flagella of the *antennules* are much longer in the male than in the female. In an ovigerous female with the carapace 4 millim. long the flagella were about 2.5 millim. in length. In a male with a carapace of 5 millim. the flagella were nearly 10 millim. The basal lobe has its anterior margin free from setæ.

The *antennal scale* (Pl. II. fig. 4, *b*) is comparatively short and broad and only a little narrowed towards the tip.

The *third maxillipeds* (Pl. II. fig. 4, *d*) are slender and the terminal joint is twice the length of the preceding. The exopod is wanting.

The *second peræopod* (Pl. III. fig. 4, *f*) on the right side is rather short and stout, reaching beyond the middle of the antennal scale. The carpus is divided into four joints by three articulations, of which the proximal is situated beyond the middle of the joint. The chela is more than half the length of the whole carpus. The left leg of the second pair reaches beyond the tip of the antennal scale, and the carpus and merus are divided by numerous annulations as in the other species. The third pair reach beyond the tip of the antennal scale, while the last pair fall a little short of it.

In the *first pleopod* of the male the endopod (Pl. IV. fig. 4, *h*) is rather triangular in shape, the internal process forming the apex, from which the outer edge curves gradually to the base, with only an indication of the outer lobe so well marked in the other species. The appendage resembles that of the female so much in general shape that it is difficult at first sight to distinguish the sexes by this character. In the second pleopods of the male the *appendix masculina* is a little shorter than the *appendix interna*.

There are about 8 pairs of spinules on the telson.

Size.—Length of our largest specimen about 25 millim.

* I have not seen this figure, the plate containing it being absent from the copy of this very rare work presented to our Museum by Prof. Milne-Edwards.

Occurrence.—This species, which ranges from Norway to the Adriatic, appears to occur all round our coasts. It is commoner on the west coast (Clyde, 5–40 fathoms: *Henderson*), but it also occurs on the east coast (Firth of Forth, rare: *T. Scott*; Firth of Tay, 1 sp.: *W. T. C.*). Norman records it as very abundant in Shetland ("Last Rep. Dredging, Shetland," Rep. Brit. Assoc. 1868, p. 265), and it extends to the south of England (Plymouth).

The following table will serve for the ready determination of the four British species of Pandalidæ:—

- | | |
|---|--|
| I. Rostrum longer than carapace, armed above with spinules only. | |
| 1. Third maxilliped without exopod. | |
| a. Carpus of second peræopod on right side with many (20) annulations. Antennal scale not much narrowed in front, outer edge straight | <i>Pandalus Montagu</i> ,
[Leach. |
| b. Carpus of second peræopod on right side with 4 annulations. Antennal scale very narrow in front, outer edge concave. | <i>Pandalus propinquus</i> ,
[G. O. Sars. |
| 2. Third maxilliped with exopod. Carpus of second peræopod, right side, with 4 annulations | |
| | <i>Pandalus Bonnier</i> ,
[Caullery. |
| II. Rostrum half the length of carapace, armed above with spines and teeth. Third maxilliped without exopod. Carpus of second peræopod, right side, with 3 annulations. . . . | |
| | <i>Pandalina brevirostris</i>
[(Rathke) |

EXPLANATION OF PLATES I.-IV.

- Fig. 1.* *Pandalus Montagu*, Leach.
Fig. 2. *Pandalus propinquus*, G. O. Sars.
Fig. 3. *Pandalus Bonnier*, Caullery.
Fig. 4. *Pandalina brevirostris* (Rathke).

Reference letters:—*a.* Carapace with rostrum. *b.* Antennal scale. *c.* Second maxilla. *d.* Third maxilliped. *e.* Tip of first peræopod, showing chela. *f.* Second peræopod of right side. *g.* Last peræopod. *h.* Endopod of first pteopod of male. *h'*. Second form of same described in *P. Montagu*.

Note.—To facilitate comparison, the figures of the same part in the different species have been drawn approximately of the same size. It will, of course, be understood from the dimensions recorded in the text that the actual sizes may be very different.

III.—On some small Mammals from the District of Cuzco, Peru. By OLDFIELD THOMAS.

THE British Museum has received a small collection of mammals obtained in the district of Cuzco by Herr Otto Garlepp, brother of the Herr Gustav Garlepp to whom science is indebted for the discovery of the remarkable mammals from Sahama, Bolivia, described in the 'Annals' for April 1898*.

In the present series there are examples of *Cebus albifrons*, *Lagothrix Humboldti*, a species of *Myotis*, *Sturnira lilium*, *Putorius macrurus*, *Dasyprocta isthmica*, *Rhipidomys leucodactylus*, *Oryzomys Stolzmanni*, *Akodon caliginosus*, and of the four following new forms:—

Sciurus aestuans cuscinus, subsp. n.

Allied to the form of the *S. aestuans* group described by Gray as "*Macroxus irroratus*"† from specimens brought by Bartlett from the Ucayali River, probably from near Sarayacu. Similar in size, dorsal coloration, and other characters to that animal, but distinguished by its much brighter and more sharply defined under surface, which is a bright yellowish buff throughout, except on the chin and throat, which are whitish. The extreme bases of the belly-hairs are slaty, but this does not show on the surface. Feet becoming more yellowish terminally, the digits, both anterior and posterior, deep orange-yellow. Yellowish ear-patches well-marked. Tail-hairs orange or ringed orange and black for their basal halves, their tips dull orange with a subterminal band of black.

Skull as in *S. irroratus*, but with much shorter nasals, which are very considerably surpassed posteriorly by the premaxillary processes. One upper premolar.

Dimensions of the type (an adult male, in skin):—

Head and body (c.) 205 millim.; tail (c.) 180; hind foot s. u.‡ (wet) 46; ear (wet) 20.

Skull: basilar length 36.1; greatest breadth 28.4; nasals, length (diagonally) 12.2; palate length from henselion 19.6; diastema 11.6; length of upper tooth-series 7.3.

Hab. Ocabamba, Cuzco.

Type B.M. no. 98. 11. 6. 8. Collected by Herr Otto Garlepp, Nov. 1, 1897.

* Ann. & Mag. Nat. Hist. (7) i. p. 277 (1898).

† Ann. & Mag. Nat. Hist. (3) xx. p. 431 (1867).

‡ s. u. = sine ungue.

Two precisely similar specimens of this squirrel are in Mr. Garlepp's collection. They may be readily distinguished from the co-types of *S. irroratus* by their yellow digits and other characters above described. They have a considerable resemblance to the Nicaraguan *Sciurus Richmondi*, Nelson *, which is evidently a member of the same group, but has a browner and less olivaceous general colour, darker belly and feet, and much longer and more posteriorly extended nasals.

S. irroratus has been amalgamated by Alston and others with *S. æstuans*; but in the present state of our knowledge I do not venture to express an opinion as to its proper status.

Nectomys Garleppii, sp. n.

Similar in most respects to *N. apicalis*, Pet., but with decidedly shorter feet and broader skull.

General colour about the same glossy greyish-brown found in *N. apicalis* and *grandis*, rather darker than in *N. palmipes*. Sides more grizzled fulvous; belly greyish white, broadly washed with dull buffy, not sharply defined laterally; throat and anal region dull whitish. Anterior part of outer surface of ear black. Upper surface of hands and feet thinly haired, brownish white; soles with 5 pads only. Hairs of tail black above and on the sides, as are most of the proximal ones below, but terminally they are mostly whitish.

Skull broadly and heavily built, although not so much so as in *N. saturatus*; nasals elongate, produced into a long median point posteriorly; supraorbital ridges widely divergent, their parietal portions markedly convex outwards.

Dimensions of the type (in skin):—

Head and body 205 millim.; tail 200; hind foot s. u. (wet) 45; ear (wet) 20.

Skull: basilar length (c.) 36; occipito-nasal length 45; greatest breadth 23·7; nasals 18·8 × 5; interorbital breadth 7·8; greatest separation of temporal ridges on brain-case 16; palate length from hensenion 21·5; diastema 13; palatal foramina 7·2 × 3·1; length of upper molar series 6·9.

Hab. Ocabamba, Cuzco.

Type B.M. no. 98. 11. 6. 21. Collected by Herr Otto Garlepp. Seven specimens examined.

This *Nectomys* is no doubt closely allied to the Guayaquil *N. apicalis*, but as the largest of seven specimens has a hind foot only 45 millim. in length, while in *apicalis* Peters's type has the same measurement 51 millim., and in two examples from N. Peru collected by Dr. Stolzmann it is 50 and

* P. Biol. Soc. Wash. xii. p. 146 (1898).

52 millim. respectively, the Cuzcan form is evidently distinct enough to deserve a name. Its skull also shows various differences, among which may be specially noted the greater spread of its temporal ridges.

Marmosa rappa, sp. n.

Allied to *M. cinerea*, Temm., but with no long fur on the base of the tail, with very long body-fur, and with deep yellow cheeks and throat.

Size about as in *M. cinerea*. Fur long, soft and fluffy, the hairs of the back about 16 millim. in length. General colour above buffy grey, the crown of the head similar to the back; centre of face yellowish, passing into the grey on the forehead. Orbital rings deep black, not very broad; a spot at base of whiskers also black, separated from the orbital rings by a narrower yellow line. Cheeks below orbital rings and lips deep orange-yellow, the hairs yellow to their bases; region between eye and ear and round the bases of the latter also yellow, but the hairs greyish proximally. Ears with a well-marked anterior basal projection. Chin deep unmixed yellow, like the cheeks. Chest, belly, and inner sides of limbs buffy yellow, darker on the chest, paler on the belly, the hairs slaty basally except just along the middle line of the belly. Mammary region reddish brown. Line of demarcation on sides quite indistinct, the buffy of the back passing gradually into the yellow of the belly. Outer sides of limbs like back, inner sides like belly; metacarpals brown above, anterior digits and whole upper surface of hind feet dull whitish. Tail practically naked from its base, the body-fur not extending on to its proximal portion; in colour, as usual, it is black proximally and white terminally, the two colours passing quite gradually into one another.

Skull in size, proportions, and the development and position of the postorbital processes very similar to Central-American examples of *M. cinerea*, therefore very different to the narrow-waisted skull of *M. regina*. Posterior part of nasals well expanded. Postorbital processes triangular, but little anterior to the broad and rounded brain-case. Middle and posterior premolars approximately equal in size.

Dimensions of the type (an old female):—

Head and body (in skin) 195 millim.; tail (dried, with vertebræ present) 223; hind foot s. u. (wet) 27.5; ear (wet) 25.

Skull: basal length 43.2, greatest breadth 25.3; nasals, least breadth 3.2, greatest breadth 6.5; interorbital breadth 9;

tip to tip of interorbital processes 11; intertemporal breadth 7·6; palate length from gnathion 26; palate breadth 14·6; combined length of *ms.*¹⁻³ 7·6.

Hab. Vilcanota River, just north of Cuzco, alt. 1500 m.

Type B.M. no. 98. 11. 1. 13. Collected by Otto Garlepp, December 1897.

"Native name Rappōsa." (The same word, but spelt "Rapozo," is also given by Mr. Hopke for *M. phæa*.)

This *Marmosa* is distinguishable from *M. cinerea* by the non-extension of the body-fur on to the tail and by its deep yellow cheeks and throat. In four young specimens sent with the adult female, and no doubt her young, the orange marking round the mouth is equally conspicuous. "*Didelphys noctivaga*," Tschudi *, agrees with it in some particulars, but the red sides described and figured in that animal readily separate the two, and perhaps indicate that Tschudi's species is a member of the rufous group allied to *M. murina*.

Marmosa quichua, sp. n.

Allied to *M. marica*, Thos., but rather larger, as large as the smaller forms of the *M. murina* group. Tail white terminally, as in *M. cinerea*.

General colour above dull fawn, not very dissimilar to that of *M. marica*, but rather darker and less wavy. Fur of back about 8 millim. in length. Black orbital rings of medium development. Lower cheeks, chin, and centre of chest buffy yellowish. Belly buffy fawn, passing gradually into the colour of the back, the hairs slaty at their bases. Upper-sides of hands and feet whitish. Tail with its basal half inch furry like the body, the remainder naked, black for its basal, white for its distal half.

Skull larger than in *M. marica*; muzzle narrow; zygomatic widely expanded, at least for their posterior halves, but anteriorly, for their orbital portions, their profile viewed from above is concave, very much as in *M. dryas*. Nasals but little expanded posteriorly. Supraorbital rims well defined, beaded, evenly divergent, but not angularly expanded. Last upper premolar slightly smaller than the middle one. Lower canine about equal to the middle premolar, twice as high as the subequal incisors and anterior premolars.

Dimensions (approximate) of the typical skin:—

Head and body 116 millim.; tail 142; hind foot s. u. (wet) 17; ear (wet) 19.

* 'Fauna Peruana,' Mamm. p. 148, pl. viii. (1845).

Skull: basal length 27·5; orbito-nasal length 31; greatest breadth 17·5; nasals 13·6 × 3·8; interorbital breadth 5·2; palate length from gnathion 16·5; palate breadth 9·6. Combined length of *ms.*¹⁻³ 5·5.

Hab. Ocabamba, Cuzco.

Type B.M. no. 98. 11. 6. 18. Collected by Herr Otto Garlepp, October 2, 1897.

This species may be readily distinguished from its allies by its marked cranial characters and its white-tipped tail, a peculiarity found in the *M. cinerea* group, but not in any of the smaller members of the genus.

IV.—On a new Species of *Marmosa*.

By OLDFIELD THOMAS.

IN working out Herr Otto Garlepp's two species of *Marmosa* the following proves also to need description:—

Marmosa phæa, sp. n.

A *Marmosa* allied to *M. cinerea*, but very much smaller.

Size about two thirds that of *M. cinerea*. Fur soft and woolly, about 11 millim. long on the back. General colour above buffy greyish brown, browner than in the grey *M. cinerea*; sides with a tinge of isabelline. Middle line of face greyish white. Orbital markings black, not sharply defined, extending forwards without interruption to the roots of the whiskers. Cheeks, chin, and chest dull buffy yellowish, much duller than in *M. rapposa*; belly buffy yellow, not sharply defined, the hairs slaty basally. Ears with a basal projection. Limbs coloured externally like back, internally like belly. Carpus, metacarpus, and tarsus brown; fingers, metatarsals, and toes whitish. Tail furry like the body for its proximal three quarters of an inch, then finely scaled, naked, brown basally, white terminally, the two colours mottled at their junction.

Skull with but very slightly developed supraorbital ridges and processes, less than in any other member of this group. Nasals well broadened, the portion behind the broadening longer than usual. Brain-case smooth and rounded, the temporal ridges scarcely perceptible. Middle and posterior premolars subequal.

Dimensions of the type (an adult female in skin):—

Head and body (c.) 132 millim.; tail (c.) 179; hind foot s. u. (wet) 21; ear (wet) 20.

Skull : length from front of interparietal to tip of nasals 34; greatest breadth 20·3; nasals, length 16·7, least breadth 3, greatest breadth 5; interorbital breadth 7; tip to tip of post-orbital processes 7·8; intertemporal breadth 7·2; palate breadth 12; combined lengths of *ms.*¹⁻³ 7·2.

Hab. San Pablo, S.W. Colombia, alt. 1500 m.

Type B.M. no. 98. 9. 5. 2. Collected by Gustav Hlopke, March 29, 1897.

The only species with which *M. phæa* could be confused is Tomes's *Didelphys Waterhousei*, and that is distinctly stated both by collector and describer to have a complete pouch, and the figure of its skull shows that it has well-marked triangular postorbital processes.

Herr Hlopke obtained two quite similar examples of *M. phæa* (both females), one of them with four young attached to its mammæ.

V.—*Description of a new Scale-Insect of the Genus Walkeriana.* By E. E. GREEN, F.E.S.

[Plate V.]

THE specimens referred to in this paper were received some time ago at the British Museum, and as the species appeared to be new, I asked Mr. Green to furnish me with a description of it. This he has kindly done, and I have now much pleasure in submitting it for publication.—CHAS. O. WATERHOUSE.

Walkeriana Andreæ, sp. n. (Pl. V.)

Adult (?) female (fig. 1) oval, convex above, with the median dorsal area slightly depressed. The whole body closely covered with granular waxy matter. Complete marginal and a dorso-lateral series of stout, bluntly tapering, dense waxy processes, those on the anterior third of the body directed forwards, the others backwards. Of these processes there are 27 in the marginal series (13 on each side and 1 from the posterior extremity) and 13 or 14 on each side in the dorso-lateral series. From between the marginal processes and from their truncate ends spring delicate silky filaments. Colour of denuded body of dried insect dark reddish brown, but this is entirely concealed above by the close covering of fulvous-white waxy matter, and below it is obscured by a thinner covering of whitish powder. Antennæ 8-jointed,

eighth longest, as long as second and third together; commencing with the longest, the antennal formula will be:—8, 3, 2, 1, (4, 5, 6), 7; each joint with a ring of stout hairs near the distal edge, except the eighth, which has similar hairs scattered irregularly over its surface and two very much longer ones on one side (fig. 3). Eye (fig. 7) prominent, conical. Legs stout, with scattered hairs and spines; a very long hair on trochanter. Foot (fig. 6) with stout curved claw; digitules four, simple tapering bristles. Tibia a little shorter than femur; tarsus less than half length of tibia. Rostral apparatus situated between first and second pairs of legs. Skin on under surface with numerous stout hairs, which are longest and whip-like on the space between antennæ and rostrum. Each hair has a small transparent collar round its base and is mounted on a prominent tubercle (fig. 4, *b*). Skin on dorsal surface thickly studded with tubular spines, stout hairs, and glandular pores of several forms (figs. 4, 5). The tubular spines are especially massed on definite tracts corresponding with the dorsal and marginal processes (fig. 2). The basal third or fourth of each spine is rather abruptly widened; the distal part slightly curved and tapering to a blunt point (fig. 4, *a*). Each spiniferous tract has a well-defined border, marked by a line of small pores with prominent thickened rims and cross-shaped orifices (fig. 5, *a*); and the marginal tracts enclose central spaces bearing a few whip-like collared hairs (fig. 4, *b*) and specialized glandular pores with very prominent rims, each with a broad duct leading down into the body for a short distance, their orifices oblong and transversely constricted (fig. 4, *c*). Scattered over the dorsal surface are other glandular pores having prominent rounded rims, with depressed centre and circular orifice (fig. 5, *b*). Anal aperture surrounded by a dense cluster of stout tapering hairs converging to the centre.

The largest of the specimens under examination measures, exclusive of waxy appendages, 8×5 millim.

Cast skins of the younger stages show a double median dorsal series of incurved waxy processes. The marginal processes are longer and more tapering than in the adult.

It is possible that the specimens under examination are immature. There is no sign of an ovisac, nor were any embryos observed in the bodies of the insects. The small number of antennal joints also is unusual for an adult Monophlebid.

Habitat on bark of unidentified tree, Congo, Africa. Col-

lected by the late Mr. G. L. E. Andræ, to whom the species has been dedicated.

Signoret founds his Monophlebid genus *Walkeriana* upon a single species from Ceylon, *W. floriger* of Walker. He has made the generic description so minute and close, including even colour and relative lengths of antennal and crural joints &c., that it is really more suitable for specific use, and would exclude anything but the typical species. I think it advisable to widen the generic characters, to admit what are evidently specifically allied insects. I have at least four other species from Ceylon that I propose to place in this genus.

EXPLANATION OF PLATE V.

Fig. 1. Female insect, dorsal view, showing waxy processes as in life.

Fig. 2. Ditto after maceration, showing spiniferous tracts.

Fig. 3. Antenna.

Fig. 4. Part of one of the marginal spiniferous tracts, showing (a) tubular spines, (b) collared hair, (c) glandular pores.

Fig. 5. Part of skin, showing (a) glandular pores from border of spiniferous tract, (b) larger pores with circular orifices.

Fig. 6. Foot.

Fig. 7. Eye.

VI.—Note on the Genus *Grammatodon*, Meek and Hayden.

By H. WOODS, M.A.

THE genus *Grammatodon* was founded by Meek and Hayden on a species of "*Arca*" from the Jurassic of the Black Hills. The name, with a reference to the type species, was published in 1860, but no diagnosis of the genus was given until 1864. The type species is *Arca (Cucullæa) inornata*, Meek and Hayden, Proc. Acad. Nat. Sci. Philad. 1858, p. 51.

In their description the authors state that *Grammatodon* is closely allied to *Macrodon*, Lycett. The type of the latter genus (*Cucullæa hirsionensis*, d'Archiac) differs from most of the other species in having the umbones placed very anteriorly. After comparing *Grammatodon* with a number of species of *Macrodon*, I am unable to detect any differences which could be regarded as of generic importance, and I consider that the two forms are identical.

It was pointed out by Meek and Hayden that the name *Macrodon* had been previously used by Müller (1842) for a genus of fishes (Characinidæ), and they proposed to substitute for it *Parallelodon*; this name has been adopted by some

authors (de Koninck, 1883; Whidborne, 1892; Hind, 1897) for the Palæozoic species. For the Triassic and Jurassic forms, however, most authors have continued to use *Macrodon*; on account of this, Beushausen (1895), instead of accepting *Parallelodon*, changed *Macrodon* to *Macrodonus*, in which he has been followed by Törnquist (1896). But the rules of priority will not allow us to accept *Macrodonus*.

If the view that *Grammatodon* is synonymous with *Macrodon*, Lycett (non Müller), be accepted, then I think it is clear that the former name must be used, since it is earlier than either *Parallelodon* or *Macrodonus*.

The references to the original descriptions of the genera above mentioned are:—

Macrodon.—Lycett, in Murchison's Geol. Cheltenham, ed. 2, by Buckman and Strickland (1845), p. 98, pl. v. fig. 5. Emended, Morris and Lycett, Mollusca Gt. Ool. (Pal. Soc. Mon.) pt. ii. (1853) p. 48, pl. v. fig. 1. Non *Macrodon*, J. Müller, Archiv für Anat. Physiol. &c. Berlin (1842), p. 308.

Grammatodon.—Meek and Hayden, Proc. Acad. Nat. Sci. Philad. 1860, p. 419 (name only and type species); "Palæontology of the Upper Missouri," Smithsonian Contrib. to Knowledge, vol. xiv. no. 172 (1864), p. 89, pl. iii. fig. 9.

Parallelodon.—Meek and Hayden, Proc. Chicago Acad. Sci. vol. i. 1866, p. 17 (nom. mut.).

Macrodonus.—L. Beushausen, "Die Lamellibr. des rheinisch. Devon," Abhandl. d. kön. Preuss. geol. Landesanst. N. F. Heft xvii. (1895), p. 36 (nom. mut.).

Woodwardian Museum,
Cambridge.

VII.—*Foraminifera from the "Cambridge Greensand."*

By FREDERICK CHAPMAN, A.L.S., F.R.M.S.

PART I.

IN a former paper* I have dealt with the Ostracoda of the Cambridge Greensand.

The present account of the Foraminifera from the Cambridge Greensand is the result of an examination of some

* See this Magazine for October 1898, pp. 331–346.

material from Swaffham, Cambridgeshire, kindly supplied me, as in the former instance, by Mr. H. Woods, of Cambridge.

From this present account we are enabled to judge somewhat of the richness of the foraminiferal fauna of this deposit, since it brings the total number of forms found to about 140.

Our previous knowledge of this group of fossils from the Cambridge Greensand has been derived chiefly from the list given by G. R. Vine*, who enumerates 31 forms from the "Greensand and Chalk-marl of Cambridge (Phosphate beds)." Some of the names there given have since been referred to other genera, owing to further studies of the Cretaceous Foraminifera; but the species will be noticed in this present paper, in the majority of cases, under their several specific names.

The Foraminifera of the Cambridge Greensand show in many cases, especially amongst the larger species, as *Cristellaria gaultina*, *Vaginulina truncata*, a marked abrasion of their tests. These specimens have therefore either been derived from an older deposit, or they have been subjected to the action of currents for a considerable time before they were covered by the deposit in which they are now found. I am, however, strongly inclined to believe that a large proportion of the microzoic fauna has been derived from the upper beds of the Gault. Other forms there are in the Cambridge Greensand, minute and well-preserved; these may or may not represent a fauna contemporaneous with the formation of the bed. It is quite possible that even the perfect and minute forms were in some cases floated off and transferred to the later deposit. The facies from this bed is remarkably like that of the Greensand seam in the Gault—zone xii.—at Folkestone.

In the following account of the Foraminifera synonymy is avoided as far as possible for the sake of brevity; and since more copious references will, in the majority of cases, be found in my papers on Gault Foraminifera from Folkestone†, the secondary references given here will mainly be from those pages. Only in cases where necessary, as in the non-occurrence of the species at Folkestone, is a fuller synonymy sometimes given.

* Proc. Yorkshire Geol. and Polytech. Soc. 1889, vol. xi. pp. 273, 274.

† See Journ. R. Mic. Soc., October 1891–February 1898 (10 parts).

Order FORAMINIFERA.

Family Miliolidæ.

Subfamily MIIOLININÆ.

SPIROLOCULINA, d'Orbigny [1826].

Spiroloculina nitida, d'Orbigny.

Spiroloculina nitida, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 298. no. 4 (Soldani, 1795, Testaceographia, vol. i. pt. 3, p. 229, pl. clv. figs. ll, mm.); Chapman, 1898, Journ. R. Micr. Soc. pp. 10, 11, pl. ii. fig. 3.

A somewhat fragmentary specimen, similar in form to that from the Gault, was found at Swaffham.

Spiroloculina tenuis (Czjzek).

Quinqueloculina tenuis, Czjzek, 1847, Haidinger's Naturw. Abhandl. vol. ii. p. 149, pl. xiii. figs. 31-34.

Spiroloculina tenuis (Czjzek), Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc. p. 551, pl. viii. fig. 2.

This species is one of the few which have not been noticed in my Gault washings from Folkestone; but it has been recorded from the Red Chalk of Speeton by Burrows, Sherborn, and Bailey.

One specimen was found at Swaffham.

MILIOLINA, Williamson [1858].

Miliolina venusta (Karrer).

Quinqueloculina venusta, Karrer, 1868, Sitzungsber. k. Ak. Wiss. Wien, vol. lvii. p. 147, pl. ii. fig. 6.

Miliolina venusta (Karrer), Chapman, 1891, Journ. R. Micr. Soc. p. 573, pl. ix. figs. 5 a & b, 6.

This is a neat little form approaching *M. tricarinata*, but with the angles of the preceding series of chambers projecting beyond and through the faces of the last-formed and enveloping series. It is a familiar species in Gault washings from the upper half of the formation.

M. venusta is common in the Cambridge Greensand of Swaffham.

Miliolina tricarinata (d'Orbigny).

Triloculina tricarinata, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 299. no. 7; Modèle, no. 94.

Miliolina tricarinata (d'Orb.), Chapman, 1891, Journ. R. Micr. Soc. p. 574, pl. ix. figs. 9 a & b.

"*Triloculina* near *T. tricarinata*, d'Orb.," were recorded by G. R. Vine from the Cambridge Greensand, and are probably referable both to the above species and to *M. venusta*.

One typical specimen only of *M. tricarinata* was found at Swaffham.

Miliolina Ferussacii (d'Orbigny).

Quinqueloculina Ferussacii, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 301. no. 18; Modèle, no. 32.

Miliolina Ferussacii (d'Orb.), Chapman, 1891, Journ. R. Micr. Soc. p. 574, pl. ix. fig. 8.

The specimens from Cretaceous deposits show a tendency to become complanate and Spiroloculine.

M. Ferussacii is fairly common at Swaffham.

Family Lituolidæ.

Subfamily LITVOLINÆ.

[Chambered forms.]

REOPHAX, Montfort [1808].

Reophax fusiformis (Williamson).

Protonina fusiformis, Williamson, 1858, Recent Foram. Gt. Britain, p. 1, pl. i. fig. 1.

Reophax fusiformis (Williamson), Chapman, 1892, Journ. R. Micr. Soc. p. 320, pl. v. fig. 3.

Several specimens, agreeing in their general contour with Williamson's species, were found at Swaffham.

Reophax scorpiurus, Montfort.

Reophax scorpiurus, Montfort, 1808, Conchyl. Système, vol. i. p. 330, 83^e genre; Chapman, 1892, Journ. R. Micr. Soc. pp. 320, 321, pl. v. figs. 4 & 5.

This form is fairly frequent at Swaffham.

Reophax folkestoniensis, Chapman.

Reophax folkestoniensis, Chapman, 1892, Journ. R. Micr. Soc. p. 321, pl. v. figs. 6 a & b.

It is noteworthy that this species was first described from the Gault of Folkestone from zone x. only.

R. folkestoniensis occurs with some frequency in the washings from Swaffham.

HAPLOPHRAGMIUM, Reuss [1860].

Haplophragmium glomeratum, Brady.

Lituola glomerata, Brady, 1878, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 433, pl. xx. figs. 1 a-c.

Haplophragmium glomeratum, Brady, 1881, Rep. Chall. vol. ix. p. 309, pl. xxxiv. figs. 15-18; Chapman, 1892, Journ. R. Micr. Soc. p. 321, pl. v. fig. 8.

A few specimens of this form were found at Swaffham.

Haplophragmium agglutinans (d'Orbigny).

Spirolina agglutinans, d'Orbigny, 1846, Foram. Foss. Vienne, p. 137, pl. vii. figs. 10-12.

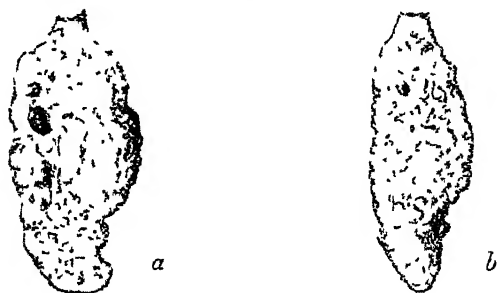
Haplophragmium agglutinans (d'Orb.), Chapman, 1892, Journ. R. Micr. Soc. p. 324, pl. v. fig. 14.

Two specimens, with somewhat coarsely textured tests, were found in the Cambridge Greensand of Swaffham.

Haplophragmium microspirale, sp. n. (Figs. 1 a & b.)

Test commencing with a small simple coil, afterwards becoming curvilinear and swollen towards the oral end. Aperture? subcrescentic. Texture coarsely arenaceous, with the exception of the commencement, which is composed of

Fig. 1.



Haplophragmium microspirale, sp. n.
a, side view; b, edge view. $\times 22$

finer arenaceous material. Colour white, from the calcareous particles of which the test is chiefly composed, but relieved here and there with dark green glauconite granules. Length about 1.7 millim.; breadth .82 millim.; thickness .6 millim.

This form approaches *H. cassis* (Parker)* in general out-

* *Lituola cassis*, Parker, 1870 (in Dawson's paper), Canad. Nat. n. s., vol. v. p. 177, p. 180, fig. 3. *Haplophragmium cassis* (Parker), Brady, 1884, Rep. Chall. vol. ix. p. 304, pl. xxxiii. figs. 17-19.

line, but is more irregular in contour and composed of very coarse material compared with the latter. The septation also is much less distinct in *H. microspirale*, and the chambers (as far as can be seen) not nearly so numerous.

H. microspirale is represented by three specimens from the Cambridge Greensand of Swaffham, Cambridgeshire.

Haplophragmium pseudospirale (Williamson).

Protonina pseudospiralis, Williamson, 1858, Recent Foram. Gt. Britain, p. 2, pl. i. figs. 2 & 3.

Haplophragmium pseudospirale, Siddall, 1879, Catal. Brit. Rec. Foram. p. 4; Brady, 1884, Rep. Chall. vol. ix. p. 302, pl. xxxiii. figs. 1-4.

This species is generally larger than *H. æquale* (Römer) and essentially differs in the compressed form of the commencement.

Several specimens were found in the washings from Swaffham. The species is one of those which were not noticed in the Gault of Folkestone.

Haplophragmium globigeriniforme (Parker and Jones).

Lituola nautiloidea, var. *globigeriniformis*, Parker and Jones, 1865, Phil. Trans. vol. clv. p. 407, pl. xv. figs. 46 & 47.

Haplophragmium globigeriniforme (P. & J.), Chapman, 1892, Journ. R. Micr. Soc. p. 324, pl. v. fig. 16.

Several specimens of the above species were found at Swaffham; in some cases the tests were attached to extraneous objects. The species was also recorded by G. R. Vine from Cambridge.

PLACOPSILINA, d'Orbigny [1850].

Placopsilina cenomana, d'Orbigny.

Placopsilina cenomana, d'Orbigny, 1850, Prodrôme Paléont. vol. ii. p. 185. no. 758.

Lituola cenomana (d'Orb.), Perner, 1892, "Ueber die Foram. des Böhm. Cenomans," in Paléont. Bohemiæ, no. i. p. 52, pl. ii. figs. 1-6, pl. iv. fig. 15.

Placopsilina cenomana, d'Orb., Chapman, 1892, Journ. R. Micr. Soc. pp. 324 & 325, pl. vi. fig. 4.

P. cenomana is rather frequent in the washings from Swaffham, and it is generally found attached to the coarser glauconite fragments found therein. Perner gives some excellent figures of this interesting form, which he found in the Cenomanian of Bohemia.

Placopsilina vesicularis, Brady.

Placopsilina vesicularis, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 51, pl. v. fig. 2; Chapman, 1892, Journ. R. Micr. Soc. p. 325, pl. vi. fig. 5.

This rudimentary form was formerly recorded as a fossil from the Gault of Folkestone only. Several examples were found in the Cambridge Greensand of Swaffham, attached to fragments of glauconite.

[*Labyrinthic forms.*]

HAPLOSTICHE, Reuss [1861].

Haplostiche Sherborniana, Chapman.

Haplostiche Sherborniana, Chapman, 1892, Journ. R. Micr. Soc. p. 325, pl. vi. figs. 6-8.

This species was originally described from zone xii. of the Gault of Folkestone.

Several specimens were found at Swaffham.

LITUOLA, Lamarck [1804].

Lituola placentula, sp. n. (Figs. 2 a & b.)

Test complanate, fairly thin in proportion to its width, composed of coarse arenaceous material. The surface of the test usually bears some slight indication of a spiral plan of growth and a shallow umbilical depression. In section the test has no definite chambered structure, but is perforated

Fig. 2.



Lituola placentula, sp. n.
a, side view; b, edge view. $\times 22$.

irregularly, as is usual in the forms with labyrinthic tests. Any regularity which might exist is obscured by the coarseness of the material used in the construction of the test. In

general appearance this form at first sight resembles *Haplophragmium acutidorsatum*, but it has no chambered structure within the test. Average breadth 1·3 millim.; thickness ·55 millim.

Concerning the arenaceous forms with a spiral commencement of Cretaceous age, it may be noticed that the majority of the earlier-described forms were referred to the genus *Lituola*. Since the restriction of this genus to labyrinthic forms, the Cretaceous species in most cases now find a place in the genus *Haplophragmium*, in which the chambers are distinct and simple as distinguished from those with irregular chamberlets or labyrinthula. The labyrinthic forms are more rudimentary from a morphological standpoint, for they indicate that the protoplasmic body gathered up the sand-grains as interstitial particles during the movement and extension of the rhizopod, just as, on the other hand, *Astrorhiza* and other allied forms in the simplest manner encrust the whole of the dactyloid mass with sand-grains, leaving only the ends free for the protrusion of the pseudopodia.

As in the fossil *Haplostiche*, *Lituola* appears to have the organic interspaces filled with secondary calcite.

L. placentula occurs with frequency in the Cambridge Greensand of Swaffham.

Subfamily *TEOCHAMMININÆ*.

AMMODISCUS, Reuss [1861].

Ammodiscus tenuis, Brady.

Ammodiscus tenuis, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. n. s. p. 51; Chapman, 1892, Journ. R. Micr. Soc. p. 326, pl. vi. fig. 12.

Two well-grown specimens of this species were obtained from Swaffham.

Family *Textulariidae*.

Subfamily *TEXTULARIINÆ*.

TEXTULARIA, DeFrance [1824].

Textularia minuta, Berthelin.

Textularia minuta (= *T. pygmæu*, Reuss), Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 26; Chapman, 1892, Journ. R. Micr. Soc. pp. 327, 328, pl. vi. fig. 15.

This species also occurs in the Gault and Red Chalk. One specimen from Swaffham.

Textularia gramen, d'Orbigny.

Textularia gramen, d'Orbigny, 1846, *Foram. Foss. Vienne*, p. 243, pl. xv, figs. 4-6; Chapman, 1892, *Journ. R. Micr. Soc.* p. 328, pl. vi, figs. 17 a & b.

Also occurring in the Gault and Red Chalk, this species is frequent in the washings of Cambridge Greensand from Swaffham.

Textularia sagittula, DeFrance.

Textularia sagittula, DeFrance, 1924, *Dict. Sci. Nat.* vol. xxxii, p. 177, vol. liii, p. 344; *Atlas, Conch.* pl. viii, fig. 5; Chapman, 1892, *Journ. R. Micr. Soc.* p. 328, pl. vi, fig. 16.

One specimen was found at Swaffham.

Textularia turris, d'Orbigny.

Textularia turris, d'Orbigny, 1840, *Mém. Soc. géol. France*, vol. iv, p. 46, pl. iv, figs. 27, 28; Chapman, 1892, *Journ. R. Micr. Soc.* pp. 328, 329, pl. vi, fig. 19.

A well-distributed Cretaceous foraminiferon. It has been previously recorded from Cambridge by G. R. Vine.

T. turris is frequent in the material from Swaffham.

Textularia praelonga, Reuss.

Textularia praelonga, Reuss, 1845, *Verstein. böhm. Kreidef.* pt. i, p. 39, pl. xii, fig. 14; Chapman, 1892, *Journ. R. Micr. Soc.* p. 329, pl. vi, fig. 23.

Three specimens were found at Swaffham.

Textularia complanata (Reuss).

Proroporus complanatus, Reuss, 1850, *Sitzungsber. d. k. Ak. Wiss. Wien*, vol. xl, p. 231, pl. xii, figs. 5 a & b.

Textularia complanata (Reuss), Chapman, 1898, *Journ. R. Micr. Soc.* p. 13, pl. ii, fig. 7.

One well-grown individual from Swaffham.

Textularia hybrida, sp. n. (Fig. 3.)

Test biserial, rapidly increasing in width towards the aboral end; sagittate in outline; compressed and of equal thickness throughout. Length .8 millim.; greatest width .4 millim.

This form is probably allied to the *Proroporus complanatus*

of Reuss, and it forms an interesting link between that species and *T. sagittula*.

Fig. 3.



Tertularia hybrida, sp. n. $\times 30$

One specimen from the Cambridge Greensand of Swaffham.

VERNEULINA, d'Orbigny [1840].

Verneulina pygmaea (Egger).

Bulmina pygmaea, Egger, 1857, Neues Jahrb. für Min. &c. p. 264, pl. xii. figs. 10, 11.

Verneulina pygmaea (Egger), Parker and Jones, 1863, Ann. & Mag. Nat. Hist. ser. 3, vol. xi. pp. 92, 93; Brady, Rep. Chall. 1884, vol. ix. p. 385, pl. xlvii. figs. 4-7.

Bulmina polystropha, Reuss, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 30, pl. ii. figs. 3a, b; Chapman, 1892, Journ. R. Micr. Soc. pp. 756, 757, pl. xii fig. 11.

Verneulina pygmaea (Egger), id. 1892, ibid. p. 43.

This species is very common in the Upper Gault of Folkestone, and the specimens from that formation are very small, with a distinctly hyaline test. It was erroneously referred to *Bulmina polystropha*, having regard to the form and not the texture of the shell.

One specimen of *V. pygmaea* was found in the Cambridge Greensand at Swaffham.

TRITAXIA, Reuss [1860].

Tritaxia tricarinata, Reuss.

Tertularia tricarinata, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 39, pl. viii fig. 60.

Tritaxia tricarinata, Reuss, 1860, Sitzungsber. d. k. Ak. Wiss. Wien, vol. xl. p. 228, pl. xiii figs. 1, 2; Chapman, 1892, Journ. R. Micr. Soc. pp. 749, 750, pl. xi. figs. 1a & b.

This species is very common in the Cambridge Greensand at Swaffham. In the larger-grown tests the white arenaceous surface is prettily relieved by some pale green glauconite granules.

Tritaxia pyramidata, Reuss.

Tritaxia pyramidata, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 32, pl. i. figs. 9 a-c; Chapman, 1892, Journ. R. Micr. Soc. p. 750, pl. x. figs. 2 a & b.

This form in the South of England is chiefly confined to the Upper Gault and Chalk-marl. It has also been found in the Gault of France and Germany.

At Swaffham this species is somewhat frequent.

SPIROPLECTA, Ehrenberg [1844].

Spiroplecta annectens (Parker and Jones). (Fig. 4.)

Textularia annectens, Parker and Jones, 1863, Ann. & Mag. Nat. Hist. ser. 3, vol. xi. p. 92, woodcut, fig. 1.

Spiroplecta annectens (P. & J.), Chapman, 1892, Journ. R. Micr. Soc. pp. 750, 751, pl. xi. figs. 3 a & b.

Four specimens of this interesting foraminiferon were found in the Cambridge Greensand of Swaffham, two of

Fig. 4.



Spiroplecta annectens (P. & J.). Specimen with uniserial outgrowth. $\times 30$.

which (see fig. 4) show the trimorphous development of the test, being at first spiral, then biserial, and finally uniserial.

GAUDRYINA, d'Orbigny [1840].

Gaudryina filiformis, Berthelin.

Gaudryina filiformis, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 25, pl. i. fig. 8; Chapman, 1892, Journ. R. Micr. Soc. p. 752, pl. xi. fig. 7.

This species is well developed and frequent at Swaffham.

Gaudryina pupoides, d'Orbigny.

Gaudryina pupoides, d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 44, pl. iv. figs. 22-24; Chapman, 1892, Journ. R. Micr. Soc. p. 752, pl. xi. figs. 8 a & b.

Very common at Swaffham. This species is, generally speaking, commonest in the Upper Gault and the Chalk-marl. It has also been recorded by Vine from Cambridge.

Gaudryina rugosa, d'Orbigny.

Gaudryina rugosa, d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 44, pl. iv. figs. 20, 21; Chapman, 1892, Journ. R. Micr. Soc. pp. 752, 753, pl. xi. figs. 9 a & b.

One specimen from Swaffham.

Gaudryina oxycona, Reuss.

Gaudryina oxycona, Reuss, 1860, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xl. p. 229, pl. xii. figs. 3 a-c; Chapman, 1892, Journ. R. Micr. Soc. p. 753, pl. xii. figs. 1 a & b.

This species is separated from *Textularia turris* by having a triserial commencement, but in other respects it is nearly similar.

Very common at Swaffham.

Gaudryina baccata, Schwager.

Gaudryina baccata, Schwager, 1866, Novara-Expéd. géol. Theil, vol. ii. p. 200, pl. iv. fig. 12.

A somewhat aberrant form, apparently linking *G. pupoides* with *G. dispansa*. *G. baccata* has not hitherto been recorded from Cretaceous beds, but is known as a Tertiary fossil, and is also found in modern deposits.

One specimen from Swaffham.

Gaudryina dispansa, Chapman.

Gaudryina dispansa, Chapman, 1892, Journ. R. Micr. Soc. p. 753, pl. xi. figs. 10 a & b.

This species was found at Folkestone in the junction-bed of the Gault and also in two of the succeeding zones.

Two specimens were found at Swaffham.

Subfamily *BULIMININÆ*.

Bulimina, d'Orbigny [1826].

Bulimina Orbignyi, Reuss.

Bulimina Orbignyi, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 38, pl. xiii. fig. 74; Chapman, 1892, Journ. R. Micr. Soc. p. 754, pl. xii. fig. 2.

Occasional specimens are met with in the Cambridge Greensand of Swaffham.

Bulimina obliqua, d'Orb.

Bulimina obliqua, d'Orb. 1840, Mém. Soc. géol. France, vol. iv. p. 40, pl. iv. figs. 7, 8; Chapman, 1892, Journ. R. Micr. Soc. pp. 754, 755, pl. xii. fig. 3.

Two specimens from Swaffham. *B. obliqua* has also been recorded from Cambridge by G. R. Vine.

Bulimina Presli, Reuss.

Bulimina Presli, Reuss, 1845, Verstein. bohm. Kreidef. pt. i. p. 38, pl. xiii. fig. 72.

Bulimina inflata, Perner, 1892, Palæont. Bohemiæ, no. 1, p. 55, pl. iii. figs. 4 a-c.

Bulimina Presli, Reuss, Chapman, 1892, Journ. R. Micr. Soc. p. 755, pl. xii. fig. 4.

To this species Perner's *B. inflata* evidently belongs, and which was obtained from the Cenomanian of Bohemia.

Very common at Swaffham.

Bulimina Presli, Reuss, var. *sabulosa*, Chapman.

Bulimina Presli, Reuss, var. *sabulosa*, Chapman, 1892, Journ. R. Micr. Soc. p. 755, pl. xii. fig. 5.

This variety was found only in zones xii. and xiii. of the Folkestone Gault.

Very common at Swaffham.

Bulimina Murchisoniana, d'Orbigny.

Bulimina Murchisoniana, d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 41, pl. iv. figs. 15, 16; Chapman, 1892, Journ. R. Micr. Soc. p. 755, pl. xii. fig. 6.

Bulimina brevicona, Perner, 1892, Palæont. Bohemiæ, no. 1, p. 54, pl. iv. figs. 1 a, b.

Several well-developed specimens with quite smooth-surfaced tests (finely arenaceous) were found in the Cambridge Greensand of Swaffham. This species was also found at Cambridge by G. R. Vine. It occurs in the Cenomanian of Bohemia, where it was described as *B. brevicona*.

Bulimina obtusa, d'Orbigny.

Bulimina obtusa, d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 39, pl. iv. figs. 5, 6; Chapman, 1892, Journ. R. Micr. Soc. pp. 755, 756, pl. xii. figs. 7 a & b.

A few specimens were found at Swaffham. It also occurred in G. R. Vine's washings from Cambridge.

Bulimina brevis, d'Orbigny.

Bulimina brevis, d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 41, pl. iv. figs. 13, 14; Chapman, 1892, Journ. R. Micr. Soc. p. 756, pl. xii. fig. 8.

A fairly common species at Swaffham.

Bulimina affinis, d'Orbigny.

Bulimina affinis, d'Orbigny, 1839, Foram. Cuba, p. 109, pl. ii. figs. 25, 26; Chapman, 1892, Journ. R. Micr. Soc. p. 756, pl. xii. figs. 10 a & b.

This form appears, from the series obtained, to graduate by the elongation of the test into *B. Orbignyi*.

Common at Swaffham.

PLEUROSATOMELLA, Reuss [1860].

Pleurostomella obtusa, Berthelin.

Pleurostomella obtusa, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 29, pl. i. figs. 9 a & b; Chapman, 1892, Journ. R. Micr. Soc. p. 757, pl. xii. figs. 13 a & b.

This species is well developed and very common in the Cambridge Greensand of Swaffham.

Pleurostomella alternans, Schwager.

Pleurostomella alternans, Schwager, 1866, Novara-Expéd. géol. Theil, vol. ii. p. 238, pl. vi. figs. 79, 80; Chapman, 1892, Journ. R. Micr. Soc. p. 758, pl. xii. figs. 14 a & b.

By the fact of the association of the preceding form with *P. alternans*, and also that the former has a megalospheric commencement succeeded by few chambers, whilst the latter is microspheric with numerous chambers, one is disposed to think that we have in these two so-called species the two generations of a single species.

P. alternans is frequent at Swaffham.

Family Lagenidæ.

Subfamily LAGENINÆ.

LAGENA, Walker and Boys [1784].

Lagena apiculata, Reuss.

Lagena apiculata, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 319, pl. i. figs. 4-8, 10, 11; Burrows, Sherborn, and

Bailey, 1890, Journ. R. Micr. Soc. p. 555, pl. ix. figs. 6, 7, 9-11;
Chapman, 1893, *ibid.* p. 581, pl. viii. figs. 2 *a* & *b* and 3 *a* & *b*.

This species is common at Swaffham.

Lagena laevis (Montagu).

Fermiculum laeve, Montagu, 1803, Test. Brit. p. 524.

Lagena laevis (Montagu), Burrows, Sheiborn, and Bailey, 1890, Journ. R. Micr. Soc. p. 555, pl. ix. fig. 3; Chapman, 1893, *ibid.* pp. 581, 582, pl. viii. fig. 5.

One specimen only from the Cambridge Greensand of Swaffham.

Lagena gracillima (Seguenza).

Amphorina gracillima, Seguenza, 1862, Foram. Monot. Mess. p. 51, pl. i. fig. 37.

Lagena gracillima (Seguenza), Chapman, 1893, Journ. R. Micr. Soc. p. 582, pl. viii. fig. 6.

One specimen from Swaffham.

Subfamily *NODOSARIINÆ*.

NODOSARIA, Lamarck [1816].

Subgenera { *GLANDULINA*, } d'Orbigny [1826].
 { *DENTALINA*, }

Nodosaria (*Glandulina*) *humilis*, Römer.

Nodosaria humilis, Römer, 1841, Verstein. norddeutsch. Kreide, p. 95, pl. xv. fig. 6; Chapman, 1893, Journ. R. Micr. Soc. p. 585, pl. viii. fig. 18.

Two specimens from Swaffham.

Nodosaria (*Glandulina*) *mutabilis*, Reuss.

Glandulina mutabilis, Reuss, 1862, Sitzungs. b. d. k. Ak. Wiss. Wien, vol. xvi. pp. 58, 91, pl. v. figs. 7, 8, 10.

Nodosaria (*Glandulina*) *mutabilis*, Reuss, Chapman, 1893, Journ. R. Micr. Soc. p. 585, pl. viii. figs. 19, 20.

Four specimens were found at Swaffham.

Nodosaria (*Glandulina*) *cylindracea*, Reuss.

Nodosaria (*Glandulina*) *cylindracea*, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 25, pl. xiii. figs. 1, 2; Chapman, 1893, Journ. R. Micr. Soc. pp. 585, 586, pl. viii. fig. 21.

One specimen from Swaffham.

Nodosaria (Dentalina) expansa, Reuss.

Dentalina expansa, Reuss, 1860, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xl. p. 188, pl. iii. fig. 4.

Nodosaria (Dentalina) expansa, Reuss, Chapman, 1893, Journ. R. Micr. Soc. p. 586, pl. viii. fig. 24.

The specimens from the Cambridge Greensand are fragments, and, in fact, no perfect specimen of this form has ever been recorded, owing, no doubt, to the slight surface-attachment between each segment.

Two specimens from Swaffham.

Nodosaria (Dentalina) farcimen, Reuss (Soldani).

Dentalina farcimen, Reuss, 1861, Bullet. de l'Acad. roy. Belg. sér. 2, vol. xv. p. 146, pl. i. fig. 18.

Nodosaria (Dentalina) farcimen, Soldani sp., Chapman, 1893, Journ. R. Micr. Soc. p. 587, pl. viii. fig. 25.

This species is undoubtedly the commonest Nodosarian form in the Cambridge Greensand. In the Gault of Folkestone *N. farcimen* was found only in the upper part.

Common in the Cambridge Greensand of Swaffham.

Nodosaria (Dentalina) soluta, Reuss.

Dentalina soluta, Reuss, 1851, Zeitschr. d. deutsch. geol. Gesellsch. vol. iii. p. 60, pl. iii. figs. 4 a & b.

Nodosaria (Dentalina) soluta, Reuss, Chapman, 1893, Journ. R. Micr. Soc. p. 587, pl. viii. fig. 26.

One imperfect specimen from Swaffham.

Nodosaria (Dentalina) gracilis, d'Orbigny.

Dentalina gracilis, d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 14, pl. i. fig. 5.

Nodosaria (Dentalina) gracilis, d'Orbigny, Chapman, 1893, Journ. R. Micr. Soc. pp. 587, 588, pl. viii. fig. 29.

One specimen from Swaffham.

Nodosaria (Dentalina) Lorneiana, d'Orbigny.

Dentalina Lorneiana, d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 14, pl. i. figs. 8, 9.

Nodosaria (Dentalina) Lorneiana, d'Orbigny, Chapman, 1893, Journ. R. Micr. Soc. p. 588, pl. viii. figs. 30, 31.

Two specimens of this form occurred at Swaffham.

Nodosaria (Dentalina) pauperata, d'Orbigny.

Dentalina pauperata, d'Orbigny, 1846, Foram. Foss. Vienne, p. 46, pl. i. figs. 57, 58.

Nodosaria (Dentalina) pauperata, d'Orbigny, Chapman, 1893, Journ. R. Micr. Soc. p. 588, pl. viii. fig. 32.

One well-grown individual was found in the Cambridge Greensand at Swaffham.

Nodosaria (Dentalina) consobrina, d'Orbigny.

Dentalina consobrina, d'Orbigny, 1846, Foram. Foss. Vienne, p. 46, pl. ii. figs. 1-3.

Nodosaria (Dentalina) consobrina, d'Orbigny, Chapman, 1893, Journ. R. Micr. Soc. p. 588, pl. viii. fig. 33.

Rare at Swaffham.

Nodosaria (Dentalina) legumen, Reuss.

Nodosaria (Dentalina) legumen, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 28, pl. xiii. figs. 23, 24; Chapman, 1893, Journ. R. Micr. Soc. p. 589, pl. viii. fig. 37.

The Cambridge-Greensand specimens are rather small, but they are not uncommon at Swaffham.

Nodosaria (Dentalina) Roemeri, Neugeboren.

Dentalina Roemeri, Neugeboren, 1856, Denkschr. d. k. Ak. Wiss. Wien, vol. xii. p. 82, pl. ii. figs. 13-17.

Nodosaria (Dentalina) Roemeri, Neugeboren, Chapman, 1893, Journ. R. Micr. Soc. pp. 589, 590, pl. viii. fig. 33.

Good typical specimens are frequent at Swaffham.

Nodosaria (Dentalina) communis, d'Orbigny.

Nodosaria (Dentalina) communis, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 254, no. 35; Chapman, 1893, Journ. R. Micr. Soc. p. 590, pl. ix. fig. 1.

This species was recorded by Vine from Cambridge. It is not a common form at Swaffham.

Nodosaria (Dentalina) mucronata, Neugeboren.

Dentalina mucronata, Neugeboren, 1856, Denkschr. d. k. Ak. Wiss. Wien, vol. xii. p. 83, pl. iii. figs. 8-11.

Nodosaria (Dentalina) mucronata, Neugeboren, Chapman, 1893, Journ. R. Micr. Soc. p. 590, pl. ix. fig. 2.

One specimen only was found at Swaffham.

Nodosaria (Dentalina) raristriata, Chapman.

Nodosaria (Dentalina) raristriata, Chapman, 1893, Journ. R. Micr. Soc. p. 591, pl. ix. fig. 4.

A single specimen was found at Swaffham.

Nodosaria perpusilla, Chapman.

Nodosaria perpusilla, Chapman, 1893, Journ. R. Micr. Soc. p. 591, pl. ix. fig. 6.

Two specimens were found at Swaffham.

Nodosaria tubifera, Reuss.

Nodosaria tubifera, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 37, pl. ii. fig. 4.

Nodosaria (Dentalina) tubifera, Reuss, Chapman, 1893, Journ. R. Micr. Soc. p. 592, pl. ix. fig. 11.

One specimen occurred at Swaffham.

Nodosaria Zippei, Reuss.

Nodosaria Zippei, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 25, pl. viii. figs. 1-3.

Nodosaria (Dentalina) Zippei, Reuss, Chapman, 1893, Journ. R. Micr. Soc. p. 593, pl. ix. fig. 12.

Two rather small specimens were found at Swaffham.

Nodosaria paupercula, Reuss.

(Fig. 5, abnormal specimen.)

Nodosaria paupercula, Reuss, Verstein. böhm. Kreidef. pt. i. p. 26, pl. xii. fig. 12.

Nodosaria (Dentalina) paupercula, Reuss, Chapman, 1893, Journ. R. Micr. Soc. p. 593, pl. ix. figs. 13, 14.

One of the specimens from the Cambridge Greensand of

Fig. 5.



Nodosaria paupercula, Reuss.
Abnormal specimen. $\times 30$.

Swaffham, consisting of three segments in a series, has a full-sized segment fused to the side of the shell (fig. 5).

This species is here well grown and frequent.

Nodosaria Fontannesii, Berthelin.

Dentalina Fontannesii, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 42, pl. ii. fig. 14.

Nodosaria (Dentalina) Fontannesii, Berthelin, Chapman, 1893, Journ. R. Micr. Soc. p. 593, pl. ix. fig. 15.

Rare at Swaffham.

Nodosaria obscura, Reuss.

Nodosaria obscura, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 26, pl. xiii. figs. 7-9.

Nodosaria (Dentalina) obscura, Reuss, Chapman, 1893, Journ. R. Micr. Soc. pp. 593, 594, pl. ix. fig. 16. (N.B.—The numbers 15 and 16 of the preceding and this species should be transposed on pl. ix.)

Two exceptionally large specimens were found at Swaffham.

Nodosaria tenuicosta, Reuss.

Nodosaria tenuicosta, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 25, pl. xiii. figs. 5, 6; Chapman, 1893, Journ. R. Micr. Soc. p. 594, pl. ix. figs. 19, 20.

This species is rare at Swaffham.

Nodosaria prismatica, Reuss.

Nodosaria prismatica, Reuss, 1860, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xl. p. 180, pl. ii. fig. 2; Chapman, 1893, Journ. R. Micr. Soc. pp. 594, 595, pl. ix. fig. 21.

Rare and small at Swaffham.

Nodosaria orthopleura, Reuss.

Nodosaria orthopleura, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 89, pl. xii. fig. 5; Chapman, 1893, Journ. R. Micr. Soc. p. 595, pl. ix. figs. 22, 23.

Two fragments only from the Cambridge Greensand of Swaffham.

VIII.—*The Land Isopoda of Madeira.*

By Canon A. M. NORMAN, M.A., D.C.L., LL.D., F.R.S., &c.

[Plate VI. figs. 1-4.]

DURING a visit to Madeira last year I collected a few Crustacea Isopoda Terrestria. M. A. Dollfus has kindly examined for me some which I was unable to determine, and among them he found one species which he regards as "new." As

this species must be described, I propose along with that description to give a list of the other species as yet known to inhabit Madeira.

Ligia italica, Aud. & Sav.

Among rocks about high-water mark ; common.

Armadilloniscus tuberculatus, A. Dollfus.

1889. *Armadilloniscus tuberculatus*, A. Dollfus, "Liste supplémentaire d'Isopodes des Açores," *Revue Biol. du France*, p. 392.

Two specimens of this species recently described from types procured by Lieut. Chaves in the Azores were found by me among stones below high-water mark at Gorgulho, near Funchal.

Lucasius scitus, Budde-Lund (= *Porcellio scitus*, Budde-Lund).

Two specimens from Madeira are in Uljanin's collection (*vide* Budde-Lund).

Lucasius Normani, A. Dollfus, sp. n. (Pl. VI. figs. 1-4.)

This new species has been submitted to M. A. Dollfus, who has decided that it is not described, and has sent me the following description, together with the figures which illustrate it:—

"Body oblong, not broad, moderately convex, covered with granulations, especially on the earlier segments; dorsal surface finely setiferous throughout. Cephalon having the lateral frontal lobes rounded; central lobe well developed, triangular, rounded, the summit blunt. Epistome a little convex, but without any true median tubercle. Eyes with fourteen ocelli. Exterior antennæ equalling the length of half the body; the flagellum almost as long as the preceding joint, its first articulation half as long as the terminal. Posterior margin of the peræon having a slight lateral sinuosity at the sides. Pleon with the lateral processes well developed; the first pleopods in the male with the exopodite broader than long and somewhat obtuse. Pleotelson much longer than broad, with the sides slightly incurved and the extremity subobtuse. Uropods having the basal joint one third shorter than the pleotelson; exopodite lanceolate, short; endopodite reaching to or very slightly extending beyond the end of the pleotelson.

"Colour pale, with two longitudinal brown bands passing down the middle and two other bands on each side; uropods light red.

"Length 6 millim., breadth 2.8 millim.

"The form of the pleotelson and the absence of any true tubercle on the epistome lead us to regard this little species as a *Lucasius*, notwithstanding that the relative length of the antennæ shows more approach to *Porcellio* (sensu stricto). It differs from *Lucanius scitus*, B.-L., which is also found at Madeira, in the longer antennæ, the greater development of the median frontal lobe, the form of the pleotelson, and the general coloration, which is particularly characteristic."

The locality in which this species occurred was the Ilheo dos Embarcadouros, the islet at the eastern extremity of Madeira. This rocky islet has a most remarkable vegetation, being the home of a large number of pretty-flowered crassifolious plants. It is, moreover, the only known locality for three interesting varieties of land-mollusca—*Helix erubescens*, Lowe, var. *advenoides*, Paiva, *Helix polymorpha*, Lowe, var. *irrasa*, Lowe, and the recently described *Helix Watsoni*, J. Y. Johnson*. This last beautifully sculptured *Helix* belongs to the group which includes *Helix tiarella*, Webbe, once living in most extraordinary profusion in Madeira, as evidenced in the fossil deposit at Caniçal, but now rare. It is a question whether this and other allies should not be united under the name *H. tiarella*, for although they do not intermingle either in locality or form, the remarkable sculpture is nearly alike in all. By a parity of reasoning to that which led Wollaston to unite a number of local forms as varieties under the name *H. polymorpha*, the species to which I refer might be aggregated under *H. tiarella*. I rediscovered the shell now named *H. Watsoni* in an extremely limited area of a few square yards only. Not being able to name the form, I showed it to my friend Mr. J. Y. Johnson, the eminent naturalist on the island. He recognized it, and brought out from his stores two or three specimens which had been found by Signor Moniz on the Ilheo dos Embarcadouros many years before. Mr. Johnson told me that Signor Moniz had no recollection of the exact spot on which he had taken it, and although it had been subsequently sought for by Signor Moniz and other friends of Mr. Johnson, it had not been again found. It was my good fortune during the two hours I spent on the islet not only to procure in plenty the species I had gone there to seek, and which are

* "Description of *Helix Watsoni*, n. sp., from Madeira," by J. Y. Johnson, *Journal of Conchology*, vol. viii. 1897, p. 429.

in abundance, but also to meet with this little *Helix* and the *Lucasius* which is here described. My rediscovery of the *H. tiarella* ally led to its description by Mr. Johnson under the name *Helix Watsoni*.

Metoponorthus serfasciatus, Budde-Lund.

I procured two specimens, which Dollfus, from their imperfect condition, doubtfully refers to this species, which had been previously found in Madeira by Dr. H. Brönniche.

Porcellio maculipes, Budde-Lund.

This has been taken twice in Madeira, and is unknown elsewhere. I did not meet with it.

Porcellio lævis, Latreille.

Very abundant in the neighbourhood of Funchal, especially in gardens and among bananas.

Porcellio dilatatus, Brandt.

Specimens are in Dollfus's collection which were found by Dr. Nodier.

Eluma purpurascens, Budde-Lund.

This species is remarkable on account of its simple eyelenses. I met with it up to heights of between 2000 and 3000 feet. Its range extends throughout the Madeiran province, it having been found both in the Canaries and Azores. It has also been met with in Portugal and Spain, and at Charente, France; but of this last locality Dollfus writes:—"où il a été certainement introduit."

Armadillidium vulgare, Latreille.

Very abundant round Funchal.

Armadillidium tigris, Budde-Lund.

Taken by Metschnikoff in Madeira and not known elsewhere (*Budde-Lund*).

Armadillidium granulatum, Brandt.

A specimen taken by Dr. H. Brönniche (*Budde-Lund*).

We thus have twelve Land Isopoda as known in Madeira. Such a list must be far from complete; and I trust that this short notice may lead others to investigate this portion of the Madeiran fauna. The Madeiran group is rich to a most remarkable degree in Land Mollusca, and it may prove to be so in Land Isopoda. With the exception of *Lucasius Normani* all the species I myself met with were collected close to Funchal. The whole of the rest of Madeira remains to be explored, and I am not aware that any carcinologist has even so much as set foot upon the islands of the Desertas and Porto Santo, which are so rich in Mollusca peculiar to them.

There are two remarkable features with respect to the Land Mollusca of the Madeiran Islands—first, that, as a rule, each form has a peculiarly restricted range in the islands, and, secondly, that out of 176 species, as recorded by Wollaston, only 25 occur in Europe.

The first of these features may be found to be paralleled hereafter among the Isopoda; but as regards the second, out of the twelve Isopoda in the preceding list, seven are European and only five are not so. However, it must be remembered that the species hitherto found have been mostly met with in the immediate neighbourhood of the seaport and from the most likely part of the island to contain introduced species. Of the five which are not European, *Armadillo-niscus tuberculatus* inhabits the Azores, while *Armadillidium tigris*, *Porcellio maculipes*, *Lucasius scitus*, and *Lucasius Normani* are, as far as is yet known, peculiar to Madeira.

The Land Isopoda have been more sought for in the Azores and Canaries than in Madeira, and thus from the former group of islands twenty species are known and from the latter nineteen.

EXPLANATION OF PLATE VI. Figs. 1-4.

Fig. 1. *Lucasius Normani*, A. Dollfus, sp. n. Head and first segment of pereon.

Fig. 2. Ditto. Head seen from below.

Fig. 3. Ditto. Fifth segment of pleon, pleotelson, and uropods.

Fig. 4. Ditto. First pleopod of the male.

IX.—*British Land Isopoda.*

By Canon A. M. NORMAN, M.A., D.C.L., LL.D., F.R.S., &c.

[Plate VI. figs. 5-12.]

SINCE the publication of Bate and Westwood's 'History of British Sessile-eyed Crustacea,' 1869*, the following papers

* Dated 1868, but the last part, which included the Land Isopoda,

have been published in which reference is made to the Land Isopoda:—

- (1) STEBBING (Rev. T. R. R.).—"On a Crustacean of the Genus *Zia*," Ann. & Mag. Nat. Hist. ser. 4, vol. xi. (1873).
- (2) NORMAN (Rev. A. M.).—"Note on the Discovery of *Ligidium agile*, Persoon, in Great Britain," Ann. & Mag. Nat. Hist. ser. 4, vol. xi. (1873).
- (3) PARFITT (E.).—"The Fauna of Devon. — Part IX. Sessile-eyed Crustacea," Trans. Devon. Assoc. Sci. Liter. & Art, 1873.
- (4) ROBERTSON (DAVID).—"Cat. Amphipoda and Isopoda of the Firth of Clyde," Trans. Nat. Hist. Soc. Glasgow, vol. ii. 1888, pp. 9-99.
- (5) SCOTT (THOMAS).—"The Land and Freshwater Crustacea of the District around Edinburgh," Proc. R. S. E. vol. xi. 1890-91, p. 75.
- (6) SCHARFF (R. F.).—"The Irish Wood-lice," Irish Naturalist, vol. iii. 1894, pp. 4-7 & 25-29.
- (7) STEBBING (Rev. T. R. R.).—"Notes on Crustacea," Ann. & Mag. Nat. Hist. ser. 6, vol. xv. 1895, p. 22.

The most important publications on the Continent, as bearing on our fauna, which have been published since Bate and Westwood, and which should be consulted by a naturalist taking up the study of the Land Isopoda, are:—

- (8) BUDDE-LUND (G.).—"Crustacea Isopoda Terrestria." Copenhagen, 1885.
- (9) DOLLFUS (A.).—"Tableaux synoptiques de la Faune Française.—Le Genre *Armadillidium*," Feuille des Jeunes Naturalistes, sér. iii. 1892 (separate copy).
- (10) DOLLFUS (A.).—"Tableau Iconographique des *Philoscia* d'Europe," Feuille des Jeunes Naturalistes, sér. iii. 1897.
- (11) SARS (G. O.).—"Account of the Crustacea of Norway." Vol. ii. Isopoda. Bergen, 1896-99.

The publications of M. A. Dollfus are very numerous; I have referred only to those which are most likely to be useful in determining species which may be found new to the British fauna. Sars, in his truly beautiful and invaluable work, fully illustrates the species of Norway, including eight species which have not yet been met with in our islands.

My object in this short paper is to draw attention to the Land Isopoda in the hope that naturalists may be induced to

look after the much neglected woodlice. Only one naturalist in our islands has ever worked at them, and that was the late Professor Kinahan, of Dublin, and in his case death prematurely cut him off when he had only for a short time investigated this group.

Dr. Scharff (6) has lately published a list of the Irish, and, indeed, of all British species known to him; but Mr. Stebbing is the only naturalist who has increased Kinahan's record. He has added three species; in the following notes I include a fourth.

I only repeat here in exceptional cases localities which are given by Kinahan or Bate and Westwood.

Ligia oceanica, Linné.

I have found this species to be generally distributed round our coasts from Shetland to Cornwall.

Ligidium hypnorum, Cuvier.

- 1792. *Oniscus hypnorum*, Cuvier, Journ. d'Hist. nat. ii. 19, i. tt. 28. 5 (sic fide Budde-Lund).
- 1793. *Oniscus agilis*, Persoon, Panzer, German Faun. ix. 24.
- 1833. *Ligidium Persoonii*, Brandt (F. A.), Conspec. Mon. Crust. Oniscod. p. 12, pl. iv. figs. 6, 12.
- 1841. *Zia agilis*, Koch, Deutschlands Crust. Heft xxxi. pls. xxii., xxiii.
- 1853. *Ligidium Persoonii*, Lereboullet, Mém. Crust. Cloport. de Strasbourg. p. 14, pl. i. fig. 1, pl. ii. figs. 20-31.
- 1859. *Ligidium Personi*, Kinahan, "Analysis of certain Genera of Terrest. Isop.", Nat. Hist. Review, vol. iv. p. 275, pl. xxi. fig. 14, pl. xxii. fig. 9.
- 1873. *Zia Saundersii*, Stebbing, Ann. & Mag. Nat. Hist. ser. 4, vol. xi. p. 286.
- 1873. *Ligidium agile*, Norman, ibid. p. 419.
- 1885. *Ligidium hypnorum*, Budde-Lund, (8) p. 254.
- 1898. *Ligidium hypnorum*, G. O. Sars, (11) p. 158, pl. lxxi.

Ligidium must be sought for in damp places. Rev. T. R. R. Stebbing has found it near Copthorn Common, Surrey.

Genus HAPLOPHTHALMUS, Schöbl, 1861.

Haplophthalmus danicus, Budde-Lund.

- 1871. *Haplophthalmus elegans*, Budde-Lund, Danmarks isopode Landskreb-lyr, Naturhist. Tidssk. 3 Række, vol. vii. p. 228 (not *H. elegans*, Schöbl).
- 1879. *Haplophthalmus danicus*, Budde-Lund, Prospect. generum specierumque Crust. Isop. terrest. p. 9.
- 1881. *Haplophthalmus Mengii*, Weber, Einige neue Isopoden Niederländischen Fauna, Tijdschr. d. Ned. Dierk. Vereen. vol. v. p. 192, pl. v. figs. 7-9 (not *Itea Mengii*, Zaddach).
- 1885. *Haplophthalmus danicus*, Budde-Lund, (8) p. 250.
- 1898. *Haplophthalmus danicus*, G. O. Sars, (11) p. 168, pl. lxxiv. fig. 2.

I have found this pretty little species in my garden here (the Red House, Berkhamsted, Herts). It occurs in company with *Trichoniscus roseus* in a cool greenhouse. The genus is allied to *Trichoniscus*. The species may be recognized by its simple eyes and the longitudinal series of tubercles which pass down the body.

Other specimens in my collection are from Denmark (*Copenhagen Mus.*). It has also been found in Norway, Holland, and France.

A near ally, *H. Mengii*, Zaddach, which is known to have a wider distribution, may be found in Great Britain. It is distinguished from its ally by having six longitudinal finely crenulated ribs passing down the body, instead of the rows of tubercles, and by the peculiarity of having two very prominent ribs on the back of the third segment of the pleon.

These species are admirably figured in Sars's beautiful work now in course of publication—a work which no carcinologist studying the Isopoda can do without.

Trichoniscus pusillus, Brandt.

Philourgria celer and *P. riparia* of Kinahan are synonyms. This little species appears to be widely distributed in our islands. My specimens are from the counties of Durham, Northumberland, and Herts, and from Connemara, Ireland. I also have it from Denmark (*Copenhagen Mus.*). Mr. T. Scott (5) finds it about Edinburgh. Exeter (*Parfitt*); Cumbrae, Scotland (*D. Robertson*).

Trichoniscus vividus, Koch.

This is *Philourgria vivida*, B. & W. Taken by Kinahan under stones and moss on hills at Portland, co. Waterford. I am not aware that it has since been found in our islands.

Trichoniscus roseus, Koch.

This is the *Philourgria rosea* of Kinahan. I have found it near Torquay and in my garden here. Mr. T. Scott records it from Tarbert on Loch Fyne, and Dr. Schaiff has taken it at Dublin and received it from Ballyfinner, co. Down.

Oniscus asellus, Linné.

This is also *O. fossor*, B. & W. It is found everywhere.

Philoscia muscorum, Scopoli.

Widely distributed.

Philoscia Couchii, Kinahan.

1885. *Ligidium Couchii*, Budde-Lund, (8) p. 257.

1885. *Philoscia longicornis*, Budde-Lunde, (8) p. 221.

1897. *Philoscia Couchii*, Dollfus, (10) p. 5 (separate copy), pl. i. fig. 1 a-c.

This species would seem to be entirely confined to the immediate neighbourhood of the sea. Salcombe, Devon (A. M. N.); Meadfoot, Torquay (Stebbing).

Its distribution has been found to be very extensive, ranging southwards along the continent of Europe, in the Mediterranean both on northern and southern coasts, in the Black Sea at Sebastopol, in the Azores and Canaries.

Platyarthrus Hoffmannseggii, Brandt.

Salcombe, Devon; Cheddar Cliffs, Somerset; garden, Red House, Berkhamsted, Herts (A. M. N.); Ide, near Exeter (Purftt); Torquay (Stebbing). Leixlip, co. Dublin, Lismore, co. Waterford, and Glengarriff, co. Cork (Scharff). Banff, Scotland (Thomas Edward, see 5).

Metoponorthus pruinosus, Brandt.

Burnmoor, co. Durham; Berkhamsted, Herts (A. M. N.); Exeter (Purftt); Banff, Scotland (Thos. Edward).

Budde-Lund unites with it *Porcellio maculicornis*, Koch, *P. frontalis*, Lereb., *Porcellionides flavo-vittatus*, Miers, and with ? before them *Porcellio truncatus*, M.-Edw., *P. zealandicus*, White, *P. immaculatus*, Fitch, and *Porcellionides Jelskii*, Miers; and to this long list of synonyms is added *P. Swammerdamii*, Aud. & Sav. It is very widely distributed, extending to Palestine, Madagascar, Sicily, North Africa, and the Canary Islands.

Metoponorthus cingendus, Kinahan.

This is *Porcellio cingendus*, Kinahan. Salcombe, Devon (A. M. N.). Mr. Stebbing has also found it in South Devon. Dr. Scharff says:—"In the mountainous districts of Dublin, Wicklow, and Cork, and also on the coast of Kerry, and on the Arran Islands it is common." Dollfus records it from France and Spain.

Porcellio scaber, Latreille.

Abundant everywhere.

Porcellio lœvis, Latreille.

I am not aware that this species has been taken in our islands by anyone since Kinahan procured it in Kent and at Dublin, and writes "common everywhere in moist places, especially in stables and litter, among grass at bottom of walls"; but Scharff nevertheless speaks of it as a rare species in Ireland, only found as yet in Kinahan's habitat.

Porcellio pictus, J. F. Brandt.

Cooper's Hill, near Cheltenham (*A. M. N.*); near Exeter (*Parfitt*). Between Leith and Portobello (*T. Scott*); Ayrshire (*D. A. Boyd*); Banff (*T. Edward*). This species may at once be recognized by its mottled body and black head.

Porcellio dilatatus, J. F. Brandt.

Headley, Surrey, and Ventnor, Isle of Wight (*Stebbing*).

Cylisticus convexus, De Geer.

1778. *Oniscus convexus*, De Geer, Mém. Ins. vol. vii. p. 553, pl. xxxv. fig. 11.

1853. *Porcellio armadilloides*, Lereboullet, Mém. Crust. Cloport. de Strasbourg, p. 65, pl. i. fig. 18, pl. iii. figs. 88-94.

1869. *Porcellio armadilloides*, Bate and Westwood, vol. ii. p. 435.

Portland, Dorset; Berkhamsted, Herts (*A. M. N.*). Salisbury Craggs, Edinburgh; Lanarkshire; Rothesay (*T. Scott*, 5). Under stones in a disused quarry at Leixlip, co. Dublin (*Scharff*, 6). Kilwinning, Scotland (*John Smith*, fide *Robertson*, 4).

Armadillidium vulgare, Latreille.

Probably occurring throughout the British Islands, but more abundant in the south. Dr. Scharff states that it has not yet been found in the west of Ireland.

Porcellidium nasatum, Budde-Lund. (Pl. VI. figs. 5-S.)

1885. *Porcellidium nasatum*, Budde-Lund, (8) p. 51.

1892. *Porcellidium nasatum*, Dollfus, (9) p. 10, fig. 12.

1895. *Porcellidium nasatum*, Stebbing, (7) p. 23.

Body shining, densely and finely punctated, smooth centrally; sides with series of depressed, wavy, elongated tubercles, more clearly seen in adult specimens, but may be

traced in the young *. Head with depressed region of the procephistome not large, but its central process greatly projecting in the form of a conspicuous quadrangular lobe, bent upwards distally, and extending forwards far beyond the lateral lobes. Antennæ with the joints of the flagellum subequal in length. Telson or pleotelson much longer than wide, tapering with concave sides to an obtusely rounded extremity. Uropods having the exopodite much longer than broad; endopodite slender and straight, not so long as the exopodite. Colour grey or somewhat plum-coloured, marked on each segment with three or five pale spots; more rarely uniformly grey.

Length 15 millim., breadth 7 millim.

The Rev. T. R. R. Stebbing has recorded this species from Leigh Woods, near Clifton, and Tunbridge Wells. I myself took it at Cheddar Cliffs, Somerset. Other specimens in my collection are from Bayonne (*A. M. N.* 1880), Biarritz (*A. Dollfus*), Rome (*Copenhagen Mus.*).

Armadillidium depressum, J. F. Brandt. (Pl. VI. figs. 9–12.)

1830. *Armadillidium depressum*, Brandt, in Brandt and Ratzeburg, *Arznei: Thiere*, vol. ii. p. 82, pl. xiii. figs. 4, 5, 6, C, D.

1833. *Armadillidium depressum*, Brandt, *Consp. Monog. Crust. Oniscod.* p. 24.

1885. *Armadillidium depressum*, Budde-Lund, (8) p. 63.

1892. *Armadillidium depressum*, A. Dollfus, (9) p. 17, fig. 25.

1895. *Armadillidium depressum*, Stebbing, (7) p. 22.

Body shining, densely punctated; a series of depressed, elongated, wavy, obliquely placed tubercles are on each side of the segments at some distance from the centre; these tubercles are often obscure, and always most evident on the earlier segments; between these rows of obscure tubercles the centre of the segments is usually smooth, but below them the sides bear scattered granules. Head with the depressed region of the procephistome extended considerably forwards in the central portion, forming a wide and conspicuous upturned lobe, the sides of which are oblique and form a sharp angle at their union with the upward sweep of the lateral processes, which do not reach nearly so far forward as the central lobe. First segment of the pereon expanded in front and extending beyond the head. Flagellum of the antennæ with the two joints of equal length. Pleotelson slightly longer than wide,

* These tubercles are similar in character to those of *A. depressum*; but whereas in that species the flattened tubercles are more pronounced than in this, especially on the first two segments, in *A. nasatum* they are less pronounced, but more equal on all the more posterior segments.

the sides scarcely incurved, the extremity truncated. Uropods having the exopodite as broad as long; the endopodite rather shorter. Colour uniformly greyish-lead or marked with spots or dashes of sulphur-yellow.

Length 17 millim., breadth 9 millim.

The Rev. T. R. R. Stebbing has found this species at Shirehampton, near Bristol, and M. A. Dollfus has specimens which were collected by Mr. Miers at Clifton.

Specimens in my collection are from Italy (*Copenhagen Mus.*) and Cap d'Antibes, Riviera (*A. Dollfus*).

The occurrence of this species in our islands is of much interest, as it was before only known in the south of Europe. *A. nosatum* is found in France; in that country it occurs abundantly in dry and sandy places in the south, but becomes scarce northwards. It has also quite recently been met with near Hamburg by Michaelsen. There is a possibility that *A. depressum* may have been introduced, since as yet it has only occurred within a few miles of the seaport of Bristol; but this cannot have been the case with *A. nosatum*, for it has been found in three distant localities, and no more unlikely place for an introduced species could be found than tufts of vegetation growing in the chinks of the great wild rocks which form the magnificent scenery of Cleddar Cliffs.

As my friend M. A. Dollfus's admirable paper on the *Armadillidia* of France is not easily accessible to English students, I have ventured to reproduce here his figures illustrative of two of the recent additions to our fauna. *Haplophthalmus danicus* will be found figured in Sars's work.

In order to show the distribution of our known species in Northern Europe, and also to indicate others which may possibly hereafter be added to our fauna, I give the following Table of Distribution (p. 78).

In the first six columns all species are recorded which are known in those countries; columns seven and eight are only given for the purpose of showing a partial extension of range of the species in the preceding columns. The Land Isopoda rapidly increase in numbers towards the south of Europe. M. A. Dollfus has recorded no less than seventy-eight species as inhabiting France and sixty-nine as found in Spain.

All the species under Norway are fully and admirably figured in Sars's beautiful work already referred to, as are also some species which he has reason to hope may yet be found in Norway—*Ligidium hypnorum*, *Trichoniscus roseus*, *Platyarthus Hoffmannseggii*, *Porcellio lœvis*, and *Armadillidium opacum*.

Distribution in Northern Europe of Crustacea Isopoda Terrestria.

	Britain.	Norway.	Sweden.	Denmark.	Holland.	Belgium.	Germany.	France.
<i>Ligia oceanica</i> , Linn.	*	*	*	*	*	*	*	*
<i>Ligidium hypnorum</i> , Cuvier	*	..	*	*	..	*	*	*
<i>Haplophthalmus Mengii</i> , Zaddach .....	..	*	..	..	..	..	*	*
— <i>danicus</i> , B.-Lund .....	*	..	..	*	*	..	*	*
<i>Trichoniscoides albidus</i> , B.-Lund .....	..	*	..	*	..	..	*	*
<i>Trichoniscus pusillus</i> , Brandt	*	*	*	*	..	*	*	*
— <i>vividus</i> , Koch .....	*	..	..	..	..	..	*	*
— <i>roseus</i> , Koch .....	*	..	..	*	*	..	*	*
— <i>pygmaeus</i> , G. O. Sars .....	..	*	..	..	..	..	*	*
<i>Philoscia muscorum</i> , Scop.	*	..	?	*	..	*	*	*
— <i>Couchii</i> , Kinahan .....	*	..	..	..	..	..	*	*
<i>Oniscus asellus</i> , Linné	*	*	*	*	*	*	*	*
<i>Platyarthus Hoffmannseggii</i> , Brandt ..	*	*	..	*	*	*	*	*
<i>Metoponorthus pruinus</i> , Brandt	*	..	*	*	..	*	*	*
— <i>cingendus</i> , Kinahan .....	*	..	..	..	..	..	*	*
<i>Porcellio Ratzeburgi</i> , Brandt .....	..	*	..	..	..	..	*	*
— <i>Rathkei</i> , Brandt .....	..	*	*	*	..	*	*	*
— <i>dilatatus</i> , Brandt	*	*	..	*	*	*	*	*
— <i>pictus</i> , Brandt	*	*	*	*	..	*	*	*
— <i>scaber</i> , Linné	*	..	*	*	*	*	*	*
— <i>laevis</i> , Latreille	*	..	*	*	*	*	*	*
<i>Cylisticus convexus</i> , Hartmann	*	*	*	*	*	*	*	*
<i>Armadillidium vulgare</i>	*	*	*	*	*	*	*	*
— <i>nasatum</i> , B.-Lund .....	*	..	..	..	..	..	*	*
— <i>pictum</i> , Brandt .....	..	*	*	*	..	*	*	*
— <i>pulchellum</i> , Zencker .....	..	*	*	*	..	*	*	*
— <i>opacum</i> , Koch .....	..	..	..	*	..	..	*	*
— <i>depressum</i> , Brandt .....	*	..	..	..	..	..	..	*
— <i>sulcatum</i> , M.-Edw. ....	..	..	..	..	..	*	..	..
	20	17	13	20	11	17	22	26

EXPLANATION OF PLATE VI. FIGS. 5-12.

- Fig. 5. *Armadillidium nasatum*, Budde-Lund. Anterior margin of head.
 Fig. 6. Ditto. Last segment of pleon, pleotelson, and uropods.
 Fig. 7. Ditto. Uropod.
 Fig. 8. Ditto. Endopodite of first pleopod of male.
 Fig. 9. *Armadillidium depressum*, Brandt. Anterior margin of head.
 Fig. 10. Ditto. Last segment of pleon, pleotelson, and uropods.
 Fig. 11. Ditto. Uropod.
 Fig. 12. Ditto. Endopodite of first pleopod of male.

X.—*A Second Recent Shell of Helix Loweï, Férussac.*
By Canon A. M. NORMAN, M.A., D.C.L., LL.D., F.R.S., &c.

1831. *Helix portosanctana*, β . *gigantea*, Lowe, Cambr. Phil. Soc. Trans. vol. iv. p. 46, pl. v. fig. 16.

1835. *Helix Loweï*, Férussac. Bull. de Zool. p. 89.

1851. *Helix Loweï*, Albers, Malacographia Maderensis, p. 82, pl. xvii. figs. 11, 12.

1878. *Helix Loweï*, Wollaston, Testacea Atlantica, p. 90.

Wollaston writes :—"The *H. Loweï* (the larger examples of which measure upwards of 2 inches across the broadest part) stands pre-eminent amongst the Madeiran *Helices* for its gigantic stature." But Wollaston need not have restricted his comparison to the shells of Madeira, for the only species in the whole Palæarctic region which equal or very slightly exceed *H. Loweï* in diameter are *Helix Codringtoni*, Gray, and *H. Pouzolzi*, Mich.; but in total bulk *H. Schleefi*, Mouss., and *H. lucorum*, Linn., are unsurpassed.

This very fine species is abundant as a fossil in the calcareous beds of Porto Santo. It was long regarded as extinct; but at length a living specimen was discovered by Signor J. M. Moniz, a collector of Mollusca in Madeira. Mr. J. Yate Johnson thus tells the tale :—"One red-letter day an active naturalist, who was in the habit of prying into out-of-the-way corners, happened to turn over a heavy stone in the islet of Cima, off Porto Santo. Imagine, brother naturalists!—for you alone can—his mingled astonishment and delight when he saw secreted beneath it a living individual of *Helix Loweï*! To compare small things with great, it was as if a traveller in the wilds of Africa were to discover a pterodactyle fluttering like a bat in the obscure depths of some previously unexplored cavern. The prize was conveyed to Funchal with the greatest care, and there it lived for some time, anxiously tended by its discoverer. Perhaps it was too much indulged in the good things of this world, for its life is supposed to have been shortened by a surfeit of cabbage (*Brassica oleracea*), a luxurious article of diet to which it had never been accustomed in its frugal home on a barren rock. It died *sine prole*, the last of its ancient race; but its shell is fondly preserved by its still disconsolate owner" (J. Y. Johnson, 'Madeira, its Climate and Scenery,' 1885, p. 211).

A second example, however, is now known. In 1892 Herr Rolle, the dealer in shells at Berlin, wrote to me offering certain shells, among them a *Helix Loweï*. In

ordering some of these I did not include the latter, since I had a sufficiency of the fossil specimens. The shells came, and a letter from Herr Rolle saying that he had also sent the *H. Loweï*, as he felt certain that I should like to have it. It may be imagined that my surprise was not unlike that of Signor Moniz when he raised the heavy stone, when, on opening the box, there lay before me a second recent specimen of this grand shell. Careful comparison with the fossils showed no differences except those produced by fossilization. The only information that Herr Rolle could give me respecting the specimen was that it came from the collection of Baron von Maltzan, recently deceased.

Wishing to have my own opinion ratified or otherwise by the highest authority, I sent the shell to Rev. R. Boog Watson, whose collection of, and knowledge with respect to, the Mollusca of Madeira is unequalled. He pronounced it to be a recent specimen of *Helix Loweï*. The question then arose whether it was Signor Moniz's specimen which had passed into the possession of Baron von Maltzan. A letter which Mr. Watson wrote to Mr. J. Y. Johnson, however, elicited the reply that the original specimen was still in the collection of Signor Moniz, and that neither he nor Mr. Johnson had ever heard of the capture of a second specimen. Lastly, when I went to Madeira last year I took my specimen with me, and Mr. Johnson entirely agreed that it was a recent shell of *H. Loweï*. When, and by whom, and in what exact locality it was found remains a mystery.

The specimen measures $1\frac{2}{10}$ inch (or 48 millim.) in diameter and $1\frac{2}{10}$ inch (or 30 millim.) high. The thinness of the shell for so large a *Helix* is remarkable, and it is translucent in every part; the weight is only 2 scruples. The colour on the under surface is pure white, on the upper the white is slightly tinged with brown; two very narrow rufous bands gird the body-whorl, the one just above, the other just below the periphery. In form and sculpture there is no difference whatever from those of the fossil shells.

Mr. Lowe, when he first described and figured this shell, suggested that the recent *Helix portosantana*, Lowe, of Madeira, might be specifically the same species as the extinct *H. Loweï*, its representative in a depauperated form. But the shells are perfectly distinct. *Helix portosantana* is not only very much smaller, the spire more depressed &c., but there are the following marked differences in sculpture:—In *H. Loweï*, both recent and fossil, the apical whorls are strongly and markedly pitted, and the underside of the shell exhibits not the slightest trace of punctuation. These features are

exactly reversed in *Helix portosantana*. The apical whorls are devoid of all pitting or punctation, while the under surface is punctated all over, similar punctation being present also on the upperside of the later whorls, though not there so conspicuously developed as on the lower surface. In other words, *Helix Lowei* has large pittings or punctures at the apex, and nowhere else. *Helix portosantana* has no pittings or punctations on the apical whorls, but has them on the later whorls. This description relates to adult shells.

XI.—On Two undescribed Cicadas from the Transvaal.

By W. L. DISTANT.

Platypleura sylvia, sp. n.

Body pilose. Head and pronotum ochraceous; head with the face and front castaneous, the carinæ black, on face enclosing two ochraceous spots; a broad black fascia between the eyes, ocelli castaneous; pronotum with the lateral angles pale ochraceous, inwardly infuscated. Mesonotum castaneous, with four large black obconical spots on anterior margin, the outermost longest and curved; a black central lanceolate spot and a spot on each anterior branch of the cruciform elevation; lateral basal margin ochraceous. Abdomen above black, posterior segmental margins castaneous. Body beneath and legs ochraceous; coxæ and trochanters spotted with black.

Tegmina semiopaque and talc-like, slightly mottled with fuscous, venation castaneous, whole costal area ochraceous; wings pale hyaline, venation castaneous, about basal half semiopaque pale ochraceous where the venation is colorous.

Opercula short, broad, considerably overlapping inwardly; rostrum not extending beyond posterior coxæ, its apex black; face with an acute central sulcation; pronotal lateral angles broadly amplified and subacutely angulated.

♂ ♀. Long. 32–33 millim.; exp. tegm. 90 millim.

Hab. Transvaal: Pretoria District (*Pret. Mus.*), Middelburg (*Kæssner*), Zoutpansberg (*Kæssner*), Lydenburg District (*Pret. Mus.* and *Coll. Dist.*).

This species is allied to *P. semiclara*, Germ., from which it differs by the much larger and more robust body, the more angulated pronotal margins, different colour and markings, and especially in the smaller ochraceous area of the wings.

P. sylvia seems, according to present knowledge, to be
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confined to the Transvaal, which is, however, decidedly improbable. I brought home two specimens with me in 1896, and during a visit to the Pretoria Museum last October I was able to inspect a fair series of both sexes.

Tibicen sirius, sp. n.

Head and thorax chocolate-brown. Head with the central area to face, anterior margin, apex of front, and area of the ocelli black. Pronotum with two blackish, narrow, central, contiguous fasciæ, widened anteriorly and posteriorly. Mesonotum with four obconical black spots, the central two smallest, the lateral ones very long; central area of cruciform elevation black. Abdomen rufous-brown, the segments more or less transversely streaked with piceous, and with a distinct series of linear black spots on each lateral margin. Head beneath and sternum palely tomentose; legs chocolate-brown, streaked with piceous; tarsi piceous, posterior femora and tarsi ochraceous; opercula dull ochraceous; abdomen beneath rufous-brown, with a faint central, longitudinal, macular, piceous fascia.

Tegmina and wings pale hyaline, both with a very distinct basal ochraceous patch; venation fuscous; wings with a small fuscous spot at apex of radial area, posterior margin of abdominal area also very distinctly fuscous.

Long. excl. tegm., ♂, 17 millim.; exp. tegm. 47 millim.

Hab. Transvaal, Lydenburg District (*Pret. Mus. and Coll. Dist.*).

This species is superficially to be recognized by the basal ochraceous areas to the tegmina and wings. The rostrum reaches the intermediate coxæ; the anterior femora are provided with two long acute spines.

XII.—*The Genus Pœcilotheria: its Habits, History, and Species.* By R. I. POCK, of the British Museum of Natural History.

[Plate VII.]

Part 1.—*Observations on the Habits and History of the Genus.*

THE genus *Pœcilotheria* is a representative of that great and almost cosmopolitan group of spiders which was formerly included under the comprehensive title *Mygale*—a term which is still to be found in many recent text-books of zoology and

also in popular works on natural history, where special reference to them is made on account of their size and alleged propensity for killing and eating small birds. The truth on this point appears to be as follows:—

Madame Merian, who was one of the first to make known the existence of these large spiders, although stating that the species she observed in Surinam feeds mostly on ants, asserted that they also take young humming-birds from their nests when the supply of insects runs short; and this description is accompanied by a coloured figure of a spider devouring one of these birds. The accuracy of this observation was subsequently confirmed by Mr. Bates, who also gave an illustration of the destruction of a small bird by one of these great spiders. A similar story accompanied by another figure is told in 'The Illustrated Natural History' by the late Rev. J. G. Wood. Thus from the small substratum of fact established by Madame Merian arose the widespread and sensational belief that the staple article of food of these spiders consists of small birds. As a matter of fact, there is no doubt that they feed almost entirely upon insects; but they will certainly also kill and devour any living animal they are powerful enough to overcome. In support of this statement and of those made by Madame Merian and Mr. Bates it may be added that during his stay in Borneo Mr. A. Everett captured a specimen of the species I have described as *Phormingochilus tigrinus* in a bird's nest, where it had killed the young bird; and that the specimen of *Pæcilotheria* described below as *P. regalis* and figured on Pl. VII. was, when captured, devouring a small rat which presumably it had killed.

Apart from diet, these large spiders differ somewhat in mode of life. Most of them live on the ground beneath stones or in deep burrows which are excavated in the soil and lined with a layer of silk, to prevent the infall of loose particles of earth or sand. Others, again, are found in trees, where they spin a light silken domicile either between forked branches, or in the hollow trunk, or in leaves rolled up for the purpose. The species of *Pæcilotheria* are now known to be tree-living forms. Colonel Yerbury, for instance, tells me that in Ceylon he discovered *P. fasciata* on trunks of trees, where they spin a light web in the angle formed by a projecting branch; and a specimen of a species closely allied to *P. regalis* that was sent from the Thana district in the Bombay Presidency by Mr. A. G. Edie fell off a tree when it was struck with an axe; lastly, the specimens of the three S.-Indian species recorded below were captured in the stacks of timber cut in the forests for fuel.

In addition to their great size, a feature in which they are scarcely surpassed by any spider in any country, the species of *Pœcilotheria* are remarkable for their varied colouring. The upperside of the body and limbs is ornamented with blotches and stripes of brown and grey; and since it is now known that the spiders live on trees, there can be no doubt that this type of coloration subserves the purpose of concealment, since it must harmonize very closely with the pattern of a tree-trunk overgrown with patches of grey lichen and moss. But the colouring of the lower side is startlingly different from that of the upper, and is quite unlike anything that is to be met with in the spiders allied to *Pœcilotheria*, though coloration of a similar kind is known to occur in many species of the families Lycosidæ, Heteropodidæ, &c. This coloration in most species consists of a deep chocolate-brown or black tint on the lower side of the thorax, abdomen, and coxæ, while the legs are nearly white or lemon-yellow, beautifully slashed with black bands and tipped with hairy pads of iridescent hue. It is at first sight puzzling to account for the existence of such colours on the lower surface of a spider, where under ordinary circumstances they cannot possibly be seen. But it is known that when molested these animals rear themselves on their hind legs and brandish the fore pairs and palpi in the air, adopting, in fact, a position in which the colours are plainly displayed to view. Some of the other spiders mentioned above belonging, *e. g.*, to the Heteropodidæ, which, although small as compared with *Pœcilotheria*, are yet of considerable dimensions, are known actually to turn on their backs when molested. Taking these facts into consideration, and remembering that black and white or black and yellow stripes constitute the badge with which Nature, for purposes of protection, has endowed poisonous or inedible animals, so that they may be at once recognized by their foes and let alone—remembering, too, that these spiders possess poison-glands of large size and are armed with irritating bristles, I have no hesitation in ascribing the unusual coloration of the under surface to the category of warning characters. They also possess a method of self-advertisement, which no doubt subserves the same end, in the form of a stridulating-organ lodged between the mandible and the palp, and consisting of vibratile club-shaped rods and of bristles which set them a-sounding.

During 1898 the British Museum received from Mr. H. R. P. Carter* representatives of three new species of *Pœcilotheria*;

* I gladly take this opportunity of expressing my great obligation to

and since the British Museum has examples of all the known species of this genus, I hasten to describe these three new forms, together with one from Ceylon, and to give a brief recapitulation of the history of the genus and of the habits of the species, so that those willing to avail themselves of the opportunity of collecting material of this group may know where to search for specimens and may learn what has been ascertained up to the present time of the species. It is hoped, too, that they may be able to determine the specimens they procure, and, particularly, may be brought to realize that in all probability many more specific representatives of this genus exist than have hitherto been discovered, so that the trouble of collecting even in localities where these spiders have already been found will be well repaid by results.

Apart from the chance that it offers of bringing new species to light, the acquisition of fresh material will teach us a great deal about such matters as the variations to which these spiders are subject as they pass from the young to the adult condition, and of the differences that obtain between the two sexes both before and after maturity.

For example, out of the four species that are here recorded from S. India, we only know the two sexes in one instance, that is to say, in the case of *P. regalis*. Of the others, *P. vittata* is represented in the British Museum collection by a single male, *P. metallica* by a single female, and *P. formosa* by several females but no male. Again, the alleged Pinang species *P. striata* is also only known from the female sex. This is true as well of the Ceylon species *P. ornata*, although fortunately in the case of the remaining two species from this island, namely *P. fasciata* and *P. subfusca*, we possess examples of both sexes. And since, owing to the great sexual differences that spiders present, our knowledge of a species is very incomplete until both male and female have been captured, it is clear that much still remains to be accomplished in the case of more than half the species that have been established.

Judging of the species of *Pœcilotheria* of which the males and females are known, it may be asserted with regard to specimens of the former sex that they resemble the females in the coloration of the *lower* surface of the body and limbs, but that the *upper* surface is much more uniformly tinted, the

Mr. Carter, who, upon learning that the National Collection was in want of these spiders, kindly wrote to his friends in S. India and used his influence to such good purpose that I am now able to add three fresh species of this genus to the faunistic lists of India.

Male bands and patches being far less clearly defined. They also resemble the females in the development of the femoral fringes on the legs; but they differ strikingly from them in the much smaller size of the body and the relatively much greater length of the limbs, and also, as in the case of all spiders, by the presence of the so-called palpal organ on the tarsal segment of the palpus or short limbs of the first pair. This is the intromittent organ of the male, and in *Pæcilo-theria* takes the form of a horny pear-shaped structure with three sharp crests running spirally round its narrow apical portion.

The earliest known species of the genus *Pæcilotheria* was described by Latreille as *Mygale fasciata*, and was based upon the figure of a large spider named *Aranea maxima ceilonica*, published in Seba's 'Thesaurus,' vol. i. pl. lxxvii. The true *fasciata*, therefore, is a Ceylonese species.

C. Koch, who was practically the first to dismember the old genus *Mygale* of Latreille and Walckenaer, in 1850 gave to this Ceylon spider the generic name *Scurria*. Unfortunately this name had three years earlier been applied to a mollusk, and since it is against the rules of zoological nomenclature for the same name to be used for two distinct animals, Simon in 1885 proposed *Pæcilotheria* to replace *Scurria* of C. Koch.

Up to 1885 the genus *Pæcilotheria*, with its supposed single species *fasciata*, was considered to be peculiar to the island of Ceylon. In that year, however, Simon recorded the occurrence of the species from Ramnad, in the Madura district of S. India (Bull. Soc. Zool. France, 1885, p. 38). Touching the accuracy of this determination, it is permissible to have doubts; nevertheless the discovery that the genus is not confined to Ceylon was important. No one, however, seems to have suspected the existence of more than one species of *Pæcilotheria* up to 1895. Early in that year I worked out the material of this genus contained in the British Museum, with the result that two well-marked, sharply defined species of the genus were found to occur in Ceylon, another in S. India, and a third in the island of Pinang*. These species were briefly described in the February number of the 'Annals.' The discovery of two species in Ceylon of course raised the whole question as to which of the two was the genuine *fasciata*. The two species seem to be equally common in the island, and it was quite certain that specimens

* For correction of this locality see note on p. 96.

of both species were preserved in the various collections in Europe and were passing under the name *fasciata*.

Reference, however, to Seba's original figure, imperfect in many respects though it be, shows that the pattern of the upperside of the abdomen in the original *fasciata* consists of a pale longitudinal band surrounded by a narrow dark brown border, whence narrow stripes of the same colour run on to the sides of the abdomen very much as is shown in the case of *P. regalis* on Pl. VII. This type of coloration is very noticeable in one of the Ceylonese species, but not so in the other. To the former therefore I restricted the name *fasciata*, and described the latter as a new species *subfusca*. The most striking differences between the two, however, do not consist so much in the pattern of the abdomen and carapace, as in that of the underside of the legs, the femoral segments of which are beautifully banded black and yellow in *fasciata*, while in *subfusca* they are of a uniform chocolate-brown tint. The other two species that were described in that paper, namely the one from Pinang and the one from S. India, have the femora banded somewhat as in *fasciata*, and two out of three from S. India and the one from Ceylon established in the following pages are similarly coloured, while the fourth more nearly approaches *subfusca* in having the femora unstriped.

Part 2.—*Descriptions of the Species.*

(1) *Pœcilotheria fasciata* (Latr.). (Pl. VII. fig. 2.)

Mygale fasciata, Latreille, Nouv. Dict. d'Hist. nat. xv. p. 304 (1803); also Hist. nat. Crust. et Ins. vii. p. 160 (1804), &c.: Walckenaer, Hist. nat. des Aranéides, iv. 1, with fig. (1806); Hahn, Monographie der Spinnen, pl. i. (1820); id. Die Arachniden, ii. p. 65, fig. 157 (1834); C. Koch, Die Arachniden, iv. p. 41, fig. 717 (1842).

Scurria fasciata, C. Koch, Uebersicht des Arachnidensyst. pt. v. p. 74 (1850).

Pœcilotheria fasciata, Simon, Bull. Soc. Zool. Fr. 1885, p. 38; Pocock, Ann. & Mag. Nat. Hist. (6) xv. p. 171*.

Loc. Ceylon (Trincomali, Kandy).

* In the above list no attempt has been made to give a complete quotation of the references to this species. The works that are cited are those that contain the original references to the name, those that contain figures of the species to which the name "*fasciata*" has been applied, and those that contain changes in the nomenclature of the genus. Nor must the inclusion of these references under one heading be taken as evidence that I consider as conspecific all the spiders that have been referred to *fasciata* by the various authors cited above. They may all belong to the same species, but the published figures and descriptions are not sufficiently accurate and detailed to carry conviction on the point.

The Museum has specimens of this species merely ticketed "Ceylon." The only examples with exact localities are an adult male and a young female from Kandy (*Col. Yerbury*) and an adult male from Trincomali (*P. Bassett-Smith*).

For the sake of comparison I append measurements * of an adult female and male example of this species:—

♀. Total length 46; length of carapace 24, width 20; length of first leg 77, of second 67, of third 55, of fourth 67; patella and tibia of first 28, of fourth 23; protarsus of fourth 17.

♂ (from Kandy). Total length 35; length of carapace 16·5, width 13·8; length of first leg 66, of second 57, of third 47, of fourth 60, of palp 31·5; tibia of fourth 13·8; protarsus of fourth 16·5, of first 15.

(2) *Pœcilotheria subfusca*, Poc.

Scurria fasciata, Ausserer, Verh. z.-b. Ges. Wien, 1871, p. 199, ♂ (not *fasciata*, Latr., C. Koch, &c.).

Pœcilotheria subfusca, Pocock, Ann. & Mag. Nat. Hist. (6) xv. p. 171 (1895).

Loc. Ceylon (Peradenia, Pundaloya).

As in the case of *P. fasciata* the British Museum has many specimens of this species from Ceylon, but only four of these have a definite locality. These are an adult male (type) and female from Pundaloya (*E. E. Green*) and a pair of females from Peradenia (*Freeman coll.*).

Ausserer failed to identify this species from want of material wherewith to check the constancy of the differences between it and *P. fasciata*. The latter was known to him only from the female, and his example of this species was a male. The colour variation between the two he regarded to be of a sexual nature.

* In this and all cases the length of the leg is taken from the base of the femur to the tip of the tarsal claws, and does not include the trochanter and coxa.

The leg measurements must, however, in certain cases be used with caution, for, as compared with the carapace, these appendages are longer in smaller (younger) than in larger specimens; in other words, with increase of size the carapace increases in length more rapidly than the legs. The total length in the table of measurements includes the carapace and abdomen, but not the jaws (mandibles). The length of the abdomen, however, is of little importance, since in living specimens it varies greatly in size in accordance with the full-fed or fasting condition of the spider, and in Museum specimens in accordance with the method of preservation, whether in a dry state or in alcohol. Since the carapace is not subject to these alterations, the relative size of two spiders may be estimated by the length of this plate, which may be taken as the standard in Arachnoid mensuration.

The following are the measurements in millimetres of the adult female collected by Mr. Freeman at Peradenia, and of the adult male obtained by Mr. Green at Pundaloya:—

♀. Total length 48; length of carapace 25, width 21; length of second leg 67, of third 58, of fourth 69; patella and tibia of second 25, of fourth 25; protarsus of fourth 17.

♂. Total length 31; length of carapace 15, width 13; length of first leg 61, of second 56, of third 48, of fourth 60; tibia of fourth 14; protarsus of fourth 16, of first 13·3.

(3) *Pæciliotheria vittata*, Poc.

Pæciliotheria vittata, Poc. Ann. & Mag. Nat. Hist. (6) xv. p. 172 (1895).

Loc. S. India or Ceylon (*Mr. Fanshawe's coll.*).

A single male example only is known.

This specimen presents the following measurements in millimetres:—

Total length 34; length of carapace 17, width 15·2; length of first leg 72, of second 63, of third 57, of fourth 66; protarsus of fourth 18, of first 17·8; tibia of fourth 15.

(4) *Pæciliotheria striata*, Poc.

Pæciliotheria striata, Poc. Ann. & Mag. Nat. Hist. (6) xv. p. 172 (1895).

Loc. Pinang (*Hardwicke coll.*).

One specimen only of this species is known. The locality assigned to it is, perhaps, erroneous, since no spider resembling a *Pæciliotheria* has been taken in Pinang by any collectors of recent years. Nevertheless, until this particular species is discovered elsewhere, which up to the present time has not taken place*, there are no conclusive reasons for rejecting the authenticity of the label on the type specimen.

The measurements of the type specimen are as follows:—

Total length 45; length of carapace 25, width 21·5; length of first leg 85, of second 72, of third 59, of fourth 74; patella and tibia of first 31, of fourth 26; protarsus of fourth 19.

(5) *Pæciliotheria regalis*, sp. n. (Pl. VII. figs. 1–1 b.)

Colour.—Head-shield or *carapace* covered above at the sides with grey hairs, tinged here and there with yellow, its middle third occupied by a pair of sinuous longitudinal bands which start on each side of the ocular tubercle and pass backwards to the posterior margin, uniting with each other

* For correction of this statement see note on p. 96.

for a short distance midway between the ocular tubercle and the thoracic fovea. *Abdomen* ornamented above with a broad whitish-yellow band, with its sinuous lateral edges bordered with deep blackish brown; sides of the upper surface pale mouse-brown, and furnished with chocolate-brown obliquely transverse stripes, which pass from the black edging of the median band to the deep chocolate-brown colouring of the lower surface; lower surface of abdomen and the epigastric area in front of the generative fold deep chocolate-brown or black, but behind the epigastric fold there is a broad transverse yellowish-red band passing right across the abdomen from side to side and embracing the posterior breathing-organs. *Mandibles* dirty greyish-brown above, black below towards the tip. *Palpi* greyish-white above, brownish on the upperside of the femur and tarsus, with black lines on the tibia and patella; lower and inner sides of femur deep velvety black; patella white below, with a brown spot on each side; tibia whitish below, tinted with brown in the middle, with a large brown patch on each side. *Legs* brown, variegated with grey; the extremities of the segments greyish white, a pair of lines of white spots on the tibiæ; tarsi with two pairs of reddish-brown spots—one pair at base, one at apex; coxæ and trochanters pale above; lower and under sides of femora, patellæ, and tibiæ of first and second legs bright lemon-yellow, of third and fourth pairs bluish white; the femora and tibiæ ornamented with a broad blackish-brown band in the distal half, but with only a very small brownish spot or stripe at the base of the inner side; these bands are narrower than the pale area at the base of the femora, but thicker than that at the tip; patella also with a brown stripe or spot at the tip, this stripe on patella of third and fourth very narrow; base of protarsus of third and fourth bluish grey.

Carapace shorter than patella and tibia of first leg, almost equal to those of second, exceeding those of fourth; patella and tibia of fourth less than of second.

Femora of *palp* fringed externally and internally; femora of first and second leg also fringed externally and internally at the apex; the trochanters of the first and second legs also fringed in front.

Measurements in millimetres.—Total length 53; length of carapace 25, width 21; length of first leg 75, of second 65, of third 55, of fourth 67; patella and tibia of first 28, of fourth 23.5; protarsus of fourth 15.8.

Loc. Arkonam in the north Arcot District of the Madras

Presidency. Taken in timber brought from the eastern Ghats (*H. R. P. Carter*).

The type of this species is a fine adult female example which Mr. Carter brought alive from India and deposited in the Zoological Gardens at Regent's Park. Unfortunately the animal did not long survive the journey to London. I am much indebted to Mr. Arthur Thomson, the keeper, for the pains he took in the preservation of the specimen and for bringing it to the British Museum, at Mr. Carter's request, when it was thoroughly dried.

The species much resembles the Ceylonese *P. fasciata* in the colouring of the body and limbs, but may be at once distinguished as from all the other known species of the genus by the presence of the broad reddish band on the lower side of the abdomen. It further differs from *fasciata* in the breadth of the bands on the lower side of the legs and the presence of the fringes of hairs on the femora of the palpi and front legs. In both of these respects it approaches the Pinang species *P. striata*. *P. striata*, however, is a longer-legged form, having the carapace shorter than the patella and tibia of the fourth leg &c. (Compare measurements of the types.)

The British Museum possesses a dry example of what appears to be a male specimen of this species from Koorg (*Mr. Macgilligan's coll.*). It presents the following measurements:—

Total length 32; length of carapace 17·5, width 15·5; length of first leg 73, of second 63, of third 52·5, of fourth 65; protarsus of first 16·3, of fourth 17·2; tibia of fourth 14·5.

We also have an immature and badly preserved female specimen from the Nilgiri Hills (*E. W. Oates*) and a very much rubbed adult female from Dahanee in the Tana district, North Konkan (*A. G. Edie*).

(6) *Pœcilotheria formosa*, sp. n.

Colouring of the upperside of trunk and limbs much like that of *P. regalis*; the brown bands on the thorax much wider and spreading more over towards the margins; the pale band on the upperside of the abdomen less noticeably lobate posteriorly, with the brown band that circumscribes it and the brown stripes that radiate from it less clearly defined; there is also a larger pale area at the extremities of the tibiae and protarsi of the legs, and the uppersides of the tarsi of the legs are not distinctly spotted; the lower sides of the legs and palpi are strongly striped, but the tibia of the palp is entirely

brown beneath, and the legs are much more of a uniform dirty white, the anterior pairs being only tinted with yellow, and the posterior pairs without the bluish tinge; the dark stripes, too, are blacker and narrower; there is, moreover, a largish black patch on the inner side of the anterior femora at the base, and there is no white distal band on the lower side of the femora of the third and fourth legs, or, at all events, at most a very narrow one spreading down from the dorsal side; and the bands on the patella of the third and fourth legs are broader than in *P. regalis*. Finally, the lower side of the abdomen is entirely chocolate-brown, without a pale band.

Legs of first and second pairs shorter than in *P. regalis*, the carapace being as long as the patella and tibia of the first leg and longer than those of the second by the grey spot on the protarsus; patella and tibia of fourth a little longer than of second; femora and trochanters of palpi and anterior legs not, or at all events only very slightly, fringed.

Stridulating-organ on maxilla consisting of a short cluster of two rows of longer and shorter clavate bristles, with usually two or three strong black tooth-like ridges removed a little distance from the distal end of the cluster.

Measurements in millimetres of type specimen.—Total length 54; length of carapace 26, width 21; length of first leg 69, of second 61, of third 54, of fourth 65; patella and tibia of first 26, of fourth 23; protarsus of fourth 16.

Loc. Kadiampatti and Mullapúram, in the Salem District, Sheveroy Hills (*H. R. P. Carter* and *H. C. West*). Taken in stacks of locomotive fire-wood.

This species differs from *P. regalis* in the characters pointed out in the diagnosis. It resembles *P. fuscata* in the absence of the femoral fringes of hair, these being the only species with banded legs in which these fringes are not developed. It, however, differs entirely from *P. fuscata* in the much whiter colour of the lower side of the legs, the much greater width of the black femoral bands, and the uniform chocolate colour of the lower side of the tibia of the palp. It is also a much shorter-legged species than *P. fuscata*, a species in which the carapace is considerably shorter than the patella and tibia of the first leg.

That this species is not based upon females of the S.-Indian species already described as *P. vittata*, which might perhaps be suspected from the fact that the two somewhat resemble each other in the whitish colour of the underside of the anterior femora, is shown by the absence of the femoral fringes, which are highly developed in *P. vittata*, by the pale

colour of the under surface of the tibia of the palp in *P. vittata*, this segment being uniformly chocolate-brown in *P. formosa*, by the presence in *P. formosa* and the absence in *P. vittata* of a dark basal patch on the inner side of the anterior femora, and by the darker colour of the underside of the femora of the third and fourth legs in *P. vittata*.

(7) *Pœcilotheria metallica*, sp. n. (Pl. VII. fig. 3.)

Colour of carapace and abdomen much as in the other species, but dark bands on the carapace more widely separated mesially and the pale band on the abdomen much less distinct and traversed by a darker stripe; upperside of legs and palpi tolerably uniformly coloured and becoming darker towards the extremities, showing faint metallic lustre; tarsi not spotted above; protarsi with a thin brown stripe; tibiæ with very indistinct lines of yellow spots; lower side of palpi entirely deep brown, with faint metallic blue lustre; lower side of anterior legs blackish brown, with strong metallic blue lustre, and a large orange-yellow patch on the under and inner sides of the base of the tibia; third and fourth legs uniformly coloured below with a similar but smaller tibial spot and much less metallic blue tint; lower side of abdomen uniformly chocolate-brown.

Carapace shorter than patella and tibia of first leg, a little longer than those of second and fourth leg; patella and tibia of fourth a little longer than of second.

Measurements in millimetres.—Total length 52; length of carapace 23.5, width 20; length of palp 37, of first leg 65, of second 59, of third 52, of fourth 64 (all measured from base of femur); patella and tibia of first 25, of second 22, of fourth 23; protarsus of fourth 15.

Loc. Near Gooty, 257 miles from Madras. A single female specimen, taken in the engineer's bungalow on the north-west line of the Madras Railway, and sent to Mr. H. R. P. Carter by Mr. H. C. West, chief engineer.

This species may be easily recognized by the uniformity of the colouring of both the upper and under sides of the legs and body, by the metallic lustre of the under surface of the legs, and the single orange-yellow patch on the tibiæ.

(8) *Pœcilotheria ornata*, sp. n.

Colour very like that of *P. fasciata*; femora of anterior legs yellow, with a black basal internal patch as in *fasciata*, but with the stripe in the distal half of the segment much broader; femora of third and fourth legs whitish below, as in

fasciata, but with the distal black stripe very broad on the third leg, and broader than the pale basal portion, and on the fourth leg as broad as the basal pale portion. In *fasciata* the black stripes on these femora are narrow, much narrower than the pale basal portion.

Further differing from *P. fasciata* in possessing, like the Indian species, a thick fringe of hairs along the outer side of the femora of the first and second leg, and in a lesser degree of the third leg. In the examples of *fasciata* known to me these fringes are not present.

Measurements in millimetres.—Total length 46; length of carapace 19, of first leg 64, of second 58, of third 49, of fourth 61; patella and tibia of first 24, of fourth 21; protarsus of fourth 15.

Loc. Ratnapura, S. Ceylon (*Rev. J. Burrows*).

The differences between this species and *P. fasciata* have been sufficiently dealt with in the description. In most of the characters in which it differs from *P. fasciata* it approaches *P. striata*, but has the femoral stripes much narrower and possesses a black patch on the inner side at the base of the anterior femora, which is absent in *P. striata*.

*Table for the Determination of the known Species of
Pœcilotheria, based upon Females.*

- a. Femora* of legs a uniform dark colour beneath and on inner side, not striped black and white or black and yellow; (anterior femora not fringed).
- a¹. Legs and palpi conspicuously banded on their upper sides, the lower and inner sides of the palpus and of the first and second legs showing a conspicuous yellow spot on the apex of the femur, the basal half of the patella and at both ends of the tibiae, the spot on the base of the tibia occupying barely one third of the length of the segment; third and fourth legs similarly banded, but with smaller spots; legs without strong metallic blue reflections below..... *subfusca*, Poc.
- b¹. Legs and palpi scarcely noticeably banded above, lower side of palpi uniformly dark-coloured; lower side of legs similarly dark-coloured, but with a large orange-yellow spot at the base of the tibia and extending over nearly half its length; legs (especially the anterior two pairs) with strong metallic blue reflection below..... *metallica*, sp. n.

* The legs of spiders consist of seven segments, named as follows from base to apex:—coxa, trochanter, femur, patella, tibia, protarsus, tarsus. In the palpus (the small front leg) the protarsus is absent.

- b. Femora of legs whitish or yellow beneath and on the inner side, the first and second pairs, and usually the third and fourth also, with a conspicuous black stripe on the distal half beneath; (femora fringed or not).
- a². Lower side of abdomen with a broad reddish transverse band behind the genital fold; (femora of palpi and anterior legs fringed; anterior legs lemon-yellow beneath, with broad black stripes; posterior legs bluish white, with broad stripes; no internal basal spot on anterior femora) *regalis*, sp. n.
- b². Lower side of abdomen a uniform chocolate-brown or black, without a broad reddish band behind the genital fold.
- a³. Tibia of palpus a uniform deep chocolate-brown beneath; (lower side of legs whitish; the anterior femora with inner basal patch and broad distal stripe; femur of third leg at most weakly banded, of fourth not banded below; their segments on the anterior legs without fringes) *formosa*, sp. n.
- b¹. Tibia of palpus pale beneath, with at most traces of black patches extending inwards from the sides of the segments.
- a¹. Femora of legs without well-developed fringes; black stripes on the lower side of anterior femora narrow, also very narrow on femur of third leg, and absent on lower side of femur of fourth (with a basal spot on inner side of anterior femora; anterior legs lemon-yellow, posterior bluish white) *fasciata*, Latr.
- b¹. Femora of legs with well-developed fringes; black stripes on lower side of femora of all the legs very broad as compared with *fasciata*.
- a¹. With a distinct black basal spot on inner side of femora of first and second pairs; black band on inner side of anterior femur only about half the width of the lemon-yellow basal portion *ornata*, sp. n.
- b¹. Without a distinct internal basal patch on the anterior femora; black band on lower side of anterior femur almost as wide as brownish-yellow basal portion of segment. *striata*, Poc.

The males may be determined as follows, neglecting for the present certain differences in the structure of the palpal organ, which are easy to detect and figure, but difficult to describe:—

- a. Lower side of femora brown, not banded; (femora of palpi and of first and second legs not fringed either externally or at the apex internally) *subfusca*, Poc.
- b. Lower side of femora of first and second legs yellow or white, with a conspicuous black stripe near the distal extremity.

- a*¹. Femora of palpi and of first and second legs with at most a small external fringe; black stripe on femora of legs narrow; a black patch at the base of these segments on the inner side; (anterior femora lemon-yellow; posterior femora chalky or bluish white) *fasciata*, Latr.
- b*¹. Femora of palpi and anterior legs with well-developed external fringe; bands on femora broader; no basal internal black patch on these segments.
- α*². Abdomen uniformly brown below, as in *fasciata*; femora of anterior two pairs of legs nearly white, of third and fourth pairs uniformly greyish brown, not distinctly banded. *vittata*, Poc.
- β*². Abdomen with broad transverse pale band behind genital fold; anterior legs lemon-yellow beneath; posterior legs bluish white and very distinctly banded with black *regalis*, sp. n.

Note on the Locality of Pœciliotheria striata.

During the passage of this paper through the press, I have received from the Bombay Natural History Society a specimen of *Pœciliotheria* ticketed S. India, and apparently specifically identical with the type and hitherto only known representative of *P. striata*. Thus the suspicions that I have always held that the alleged locality for this species, namely Pinang, would prove to be more than doubtful, and that the species itself would turn up either in India or Ceylon, are amply confirmed. In view of this discovery, I think we may confidently regard *Pœciliotheria* as peculiar to S. India and Ceylon, where it is now known to be represented by eight species.

In the same consignment of spiders from Bombay is a specimen of *P. regalis* from Matheran, which shows that this species has a wide range in S. India.

EXPLANATION OF PLATE VII.

- Fig. 1.* *Pœciliotheria regalis*, sp. n., nat. size, drawn from photograph of female example from Arkonam.
- Fig. 1a.* Ditto. Lower side of abdomen of same specimen, showing pale yellowish-red band (*a*) behind genital fold.
- Fig. 1b.* Ditto. Front leg from inner aspect, showing black band (*a*) and fringe (*b*) on femur.
- Fig. 2.* *Pœciliotheria fasciata*, Latr. Inner view of front leg for comparison with *1b*, showing thin stripe (*a*) and basal black patch (*b*) on femur; also the absence of femoral fringe.
- Fig. 3.* *Pœciliotheria metallica*, sp. n. Inner view of front leg, showing uniform dark colour with exception of orange-yellow tibial spot.

XIII.—*Notes on the Family Hetrodidæ, with a List of the described Species.* By W. F. KIRBY, F.L.S., F.E.S., &c.

THE family Hetrodidæ includes a number of rather large spiny apterous Orthoptera, a synopsis of which was published by Dr. Karsch in 1887 in the 'Berliner entomologische Zeitschrift,' vol. xxxi. Several additional species have been described since. I have just completed the rearrangement of the specimens in the Natural History Museum, and have made several notes on synonymy &c., which I thought it would be useful to publish at once, and I prefix a list of all the species hitherto described.

With the exception of one or two species which are said to occur in Asia Minor, the family is wholly African, and the species appear to be more numerous in Eastern and, perhaps, Southern Africa than on the West Coast. The Spanish and North-African genus *Pynogaster*, Graells, is now referred by Brunner von Wattenwyl to the family Ehippigeridæ instead of to the Hetrodidæ.

The synonymy of the true Hetrodidæ is given by Karsch in the paper just quoted, and I have therefore only given full references where additions or corrections were required.

Species marked † are wanting in the Museum collection; ‖, as usual, denotes a preoccupied name; * denotes type of genus.

List of described Species of Hetrodidæ.

Family Hetrodidæ.

Subfamily HETRODINÆ.

HETRODES, Fischer de Waldheim (1833).

- *1. *Hetrodes pupus*, Linn.—Africa, Cape Verde Islands, Asia Minor.

[Typ. fig., Roesel, Insectenbelust. ii. Heuschrecken, tab. vi. fig. 3.]

Hetrodes pupa et *spinulosus*, F. de W. Orth. Ross. pp. 368, 369, pl. xxxiv. figs. 1, 2 (1846).

2. *Hetrodes productus*, Walker, Cat. Derm. Salt. ii. p. 227. n. 4 (1869).—Congo.

3. *Hetrodes macrurus*, Walker, l. c. p. 228. n. 6 (1869).—?

4. *Hetrodes marginatus*, Walker, l. c. p. 226. n. 3 (1869).—Cape.

5. *Hetrodes abbreviatus*, Walker, l. c. p. 227. n. 5 (1869).—S. Africa.

†6. *Hetrodes Bachmanni*, Karsch.—Troe Troe, W. Cape Colony.

†7. *Hetrodes variolosus*, Fieber.—?

Hetrodes variolosus, Fieber, Lotos, iii. p. 259 (1853).

ACANTHOPLUS, Stål (1873).

§ Femora spined beneath.

*1. *Acanthoplus longipes*, Charpentier.—Benguela, Congo.

§§ Femora not spined; no spines on front margin of pronotum.

2. *Acanthoplus pallidus*, Walker.—E. Africa.

Hetrodes pallidus, Walk. Cat. Derm. Salt. ii. p. 231. n. 20 (1869).

3. *Acanthoplus discoidalis*, Walker.—S. Africa.

Hetrodes discoidalis, Walk. l. c. p. 230. n. 18 (1869).

†4. *Acanthoplus Speiseri*, Brancsik, Trencs. Várm. Term. Egylet, 1894-5, p. 258, pl. viii. fig. 9 a-d (1896).—Zambesi.

5. *Acanthoplus desertorum*, Kirby (*vide infra*).—Kalahari Desert.

6. *Acanthoplus serratus*, Kirby (*vide infra*).—King William's Town, S. Africa.

7. *Acanthoplus germanus*, Kirby (*vide infra*).—King William's Town.

†8. *Acanthoplus stratiotes*, Brancsik, l. c. p. 259, pl. viii. fig. 10 a-d (1896).—Zambesi.

§§§ Femora not spined; two central spines on front margin of pronotum.

†9. *Acanthoplus Jallæ*, Griffini, Boll. Mus. Zool. Torino, xii. no. 290, p. 3 (1897).—Zambesi.

CLOANTHELLA, Bolivar (1890).

Cloanthella, Bol. Jorn. Sci. Lisboa, (2) i. p. 226 (1890).

*†1. *Oloanthella clypeata*, Bol. l. c.—Braganza.

COSMODERUS, Lucas (1868).

- *1. *Cosmoderus erinaceus*, Fairmaire.—Gaboon, Cameroons, French Congo.
Ephippiger erinaceus, Fairmaire, Thomson, Archives Ent. ii. p. 260, pl. ix. fig. 1 (1858).
- 2. *Cosmoderus Kingsleyæ*, Kirby, Ann. & Mag. Nat. Hist. (6) xviii. p. 260, pl. xii. fig. 7 (1896).—Ogové.

APROPHANTIA, Kirby (1896).

[Kirby, Ann. & Mag. Nat. Hist. (6) xviii. p. 261, note (1896).]

- *1. *Aprophantia maculata*, Kirby, l. c. pl. xii. fig. 8 (1896).—Cameroons.

ENYALIOPSIS, Karsch (1887).

Types *E. ephippiatus* and *E. Petersii*.

- 1. *Enyaliopsis ephippiatus*, Gerstaecker.—Zanzibar.
Eugaster ephippiatus, Gerstaecker, Arch. f. Nat. xxxv. p. 213 (1869); Von der Decken's Reisen, iii. (2) p. 27, Taf. ii. fig. 2 (1873).
- 2. *Enyaliopsis Petersii*, Schaum.—E. Africa.
- †3. *Enyaliopsis Bloyeti*, Lucas.—Kondoa, E. Africa.
- 4. *Enyaliopsis Durandi*, Lucas.—Zainbesi.
- †5. *Enyaliopsis obuncus*, Bolivar.—Angola.
Enyalis obuncus, Bol. Jorn. Sci. Math. Lisboa, viii. p. 119 (1881).

GYMNOPROCTUS, Karsch (1887).

- †1. *Gymnoproctus abortivus*, Serville.—Senegal, Soudan.
Eugaster Maurelii, Lucas (sec. Karsch).

Subfamily EUGASTRINÆ.

ANEPISCEPTUS, Fieber (1853).

Pornotrips, Karsch (1887).

- †1. *Anepisceptus horridus*, Burmeister (type of both the above generic names).—Syria, Arabia, Egypt.
||*Hetrodes spinulosus*, Charpentier.

2. *Anepisceptus Servillei*, Reiche and Fairmaire.—Abyssinia, Somali.
Hetrodes Servillei, R. & F., Ferret and Galinier, Voy. Abyss. iii. p. 426, pl. xxviii. fig. 1 (1847).
- †3. *Anepisceptus Revoilii*, Lucas.—Somali.
- †4. *Anepisceptus hippolyti*, Kirby (*vide infra*).—Abyssinia.
Eugaster Servillei, Lucas, Ann. Soc. Ent. France, (4) ix. p. 83, pl. iii. figs. 1-6 (1869).
5. *Anepisceptus Ruspolii*, Schulthess-Rechberg.—Somali.
Pornotrips Ruspolii, S.-R. Zool. Jahrb. Syst. viii. p. 81, pl. iv. fig. 4 (1894).
6. *Anepisceptus suakimensis*, Kirby.—Suakim.
Eugaster suakimensis, Kirby, Ann. & Mag. Nat. Hist. (6) xvii. p. 122 (1896).
- †7. *Anepisceptus Robecchii*, Schulthess-Rechberg.—Somali.
Pornotrips Robecchii, S.-R. Ann. Mus. Genov. (2) xix. p. 209, pl. ii. figs. 15, 15 a (1898).

EUGASTER, Serville (1839).

1. *Eugaster spinulosus*, Linné.—Morocco.
[Typ. fig. Edwards, Gleanings Nat. Hist. ii. p. 161, pl. cclxxxv. figs. 3-5 (1760).]
Eugaster spinulosus, Kirby, Ent. M. Mag. xxvii. pp. 210, 295 (1891).
2. *Eugaster frater*, Kirby, Ann. & Mag. Nat. Hist. (6) xvii. p. 123 (1896).—Mombasa.
3. *Eugaster Woodii*, Kirby, Ent. Monthly Mag. xxvii. p. 211 (1891).—Somali.
4. *Eugaster loricatus*, Gerstaecker, Arch. f. Nat. xxxv. p. 213 (1869); Von der Decken's Reisen, iii. (2) p. 26, pl. ii. fig. 1 (1873); Karsch, Berl. ent. Zeitsch. xxxi. p. 65 (1887), xxxii. p. 463 (1888).—Zanzibar.
5. *Eugaster Powysi*, Kirby, *l. c.* p. 294 (1891).—Morocco.
- *6. *Eugaster Guyoni*, Serville.—Algeria.
Eugaster Guyoni, Kirby, *l. c.* p. 295 (1891); Vosseler, Jahreshefte Ver. Württemb. xlix. p. xciii (1893); Finot, Ann. Soc. Ent. France, lxxv. p. 558 (1897).
Eugaster spinulosus, pt., Karsch (excl. syn.), *l. c.* xxxi. p. 65 (1887).

7. *Eugaster Lucasi*, Kirby, *l. c.* p. 295 (1891).—Tunis.
Hetrodes Guyoni, var., Lucas, Bull. Soc. Ent. France, (2) ix. p. 4 (1851).
Eugaster Guyoni, Lucas, Ann. Soc. Ent. France, (4) i. p. 217 (1861);
 White, Proc. Ent. Soc. Lond. 1888, p. xxv.
Eugaster Guyoni, var. *Lucasi*, Krauss, Jahreshefte Ver. Württemb.
 xlix. p. xcvi (1892); Zool. Jahrb. Syst. ix. p. 552 (1897).
- †8. *Eugaster inornata*, Krauss.—Oran.
Eugaster Guyoni, var. *inornata*, Krauss, *ll. cc.* (1892, 1897).
 || *Eugaster Guyonii*, Karsch, *l. c.* xxxii. p. 462 (1888).

ACANTHOPROCTUS, Karsch (1887).

- †1. *Acanthoproctus* (?) *capreolus*, Pictet, Mém. Soc. Genève, xxx. (6) p. 69, pl. iii. figs. 33, 33 a (1889).—S. Africa.
- *2. *Acanthoproctus cervinus*, De Haan.—Cape.
Hetrodes fortis, Walker, Cat. Derm. Salt. ii. p. 229. n. 11 (1869).
3. *Acanthoproctus militaris*, White, Methuen, Life in Wilderness, p. 316, pl. i. fig. 4 (1846).—S. Africa.
4. *Acanthoproctus Howarthæ*, Kirby (*vide infra*).—E. Karoo, Cape Colony; Brak Kloof, near Grahamstown.

HEMIHETRODES, Pictet (1889).

- Hemihetrodes*, Pictet, Mém. Soc. Genève, xxx. (6) p. 74 (1889).
1. *Hemihetrodes vittatus*, Walker.—S. Africa.
Hetrodes vittatus, Walker, Cat. Derm. Salt. ii. p. 229. n. 12 (1869).
Hemihetrodes Peringueyi, pt., Pictet, *l. c.* pl. iii. figs. 30, 30 a (1889).
2. *Hemihetrodes Peringueyi*, Pictet, *l. c.*—S. Africa.

APHRACTIA, Kirby (*vide infra*).

- || *Enyalis*, Stål, Cefv. Vet.-Akad. Förh. xxxiii. (3) p. 58 (1876).
Eugaster, div. a, Stål, Rec. Orth. ii. p. 22 (1874).
1. *Aphractia diademata*, Stål (1858).—S. Africa.
Hetrodes crassipes, Walker, Cat. Derm. Salt. ii. p. 231. n. 19 (1869).
Acanthoproctus ibex, Pictet, Mém. Soc. Genève, xxx. (6) p. 72, pl. iii. figs. 31, 31 b (1889).

MADIGA, Kirby (1896).

- Madiga*, Kirby, Ann. & Mag. Nat. Hist. (6) xvii. p. 124 (1896).
 || *Prionocnemis*, Karsch.

*1. *Madiga verrucifera*, Karsch.—Mombasa.

Prionocnemis verruciferus, Karsch, Berl. ent. Zeitschr. xxxi. p. 67, Taf. ii. fig. 3 (1887); Ent. Nachr. xiii. p. 261 (1887).

†2. *Madiga aberrans*, Schulthess-Rechberg.—Somali.

Prionocnemis aberrans, S.-R. Ann. Mus. Genov. (2) xix. p. 210, pl. ii. figs. 16, 16 a (1898).

SPALACOMIMUS, Karsch (1887).

1. *Spalacomimus talpa*, Gerstaecker.—Zanzibar.

Eugaster talpa, Gerst. Arch. f. Nat. xxxv. p. 214 (1869); Von der Decken's Reisen, iii. (2) p. 28, Taf. ii. fig. 3 (1873).

BRADYOPISTHIUS, Karsch (1887).

1. *Bradyopisthius paradoxurus*, Karsch.—Somali.

[To be continued.]

XIV.—*New Species of Oriental Lepidoptera.*

By Colonel C. SWINHOE, M.A., F.L.S.

Fam. Nymphalidæ.

Subfam. EUPLOGINÆ.

1. *Caduga ethologa*, nov.

♂ ♀. The Perak form of *C. tytia*, Gray, figured by Distant in Rhop. Malay. pl. xli. fig. 15, differs constantly from both Indian and Chinese forms in the long series before me, not in the division or otherwise of the large pale spot in the anterior wings between the second and third medial nervules as stated by Distant (p. 409), this character being inconstant in the group, but in the difference in the form of the subapical hyaline streaks of the fore wings, which is very characteristic in the group—the lower streak being short and the upper ones reduced to mere spots, whereas in *tytia* the lower streak is always long; the fore wing of this form is also much shorter than it is in *tytia*, the apex less produced, and the outer margin more abrupt.

Expanse of wings $3\frac{1}{2}$ inches.

Perak. Many examples.

This form is in the B. M. from Perak, unnamed.

2. *Penoa evalida*, nov.

♂ ♀. Differs from *P. alcathoë*, Godt., in the hind wing having the discal streaks short, these streaks, as also the submarginal spots, obscured, being suffused with brown; the female differs from the male only in having the markings more pronounced.

Expanse of wings, ♂ $4\frac{2}{10}$, ♀ $4\frac{7}{10}$ inches.

Perak. Many examples.

Not referred to by Distant in his Rhop. Malay.; it is the Perak form of *P. alcathoë*, but the markings of the hind wings, instead of being pure white as in that species, are as obscure as in *P. Pinwilli*, Butler, and *P. Menetriesii*, Felder.

3. *Calliplœa musa*, nov.

♂ ♀. Dark blackish brown, with very faint blue gloss on outer portions of fore wings; spots violet, one near costa above end of cell, one in the cell at its lower end, one below it in interno-median area, all three in a line; in the female there is a fourth spot in the interspace between the cell-spot and the lower spot; there is a spot outside the cell, and another above it, a submarginal row of seven spots with whitish centres: hind wings paler and more brown, with the usual grey glandular patch, extending halfway into the cell in the male, the grey costal space limited by the subcostal vein in the female; three submarginal spots in the upper interspaces. Underside uniform pale brown, spots grey; fore wings with one near costa above end of cell, one inside lower end of cell, one large and oval-shaped in the interspace below, a spot in each of the two discocellular interspaces, submarginal and marginal spots in each interspace, the latter very small; hind wings with white dots at the base, and small submarginal and marginal spots in each interspace.

Expanse of wings $3\frac{2}{10}$ inches.

Tonkin. 4 ♂♂, 1 ♀.

Allied to nothing I know of: marked like a *Salpinx*.

Subfam. *NYMPHALINÆ*.4. *Precis neglecta*, nov.

♂ ♀. Upperside dark brown tinged with pink: fore wing with a broad pinkish-grey band across the centre of the cell and continued to the hinder margin, a similar band across the end of the cell; discal and submarginal broad bands of the same colour across both wings, the discal band being interrupted opposite the end of the cell of the fore wings by a

brown elbowed mark of the ground-colour of the wing, both wings also with a thin pinkish band close to the outer margin. Underside with the ground-colour dull ochreous tinged with pink; the fore wings crossed by four bands, the discal one much indented; the hind wing with an antemedial irregular band, a nearly straight discal brown line with a pale inner edge; a discal row of small ocelli, with white centres and ringed with brown, across both wings, also a submarginal sinuous brown line in both wings.

Expanse of wings $2\frac{7}{10}$ inches.

Sandakan, Borneo. 8 ♂♂, 1 ♀.

Belongs to the *iphita* group; it is in the B. M. unnamed.

5. *Athyma gynea*, nov.

♂. Upperside black, markings milk-white, a narrow streak in the cell, extending slightly beyond it in a spear-shaped end; three subapical spots, the middle one the largest; a discal band, running nearly parallel with the discoidal streak, composed of three conjoined spots merely divided by the veins, the upper one a large oval in the first median interspace; a submarginal pale line whitish near the hinder angle, ending in a prominent orange spot near the apex: hind wings with a broad antemedial band, this and the discal band of the fore wings being continuous and edged with blue; a narrow discal band of pure white spots, a pale thin submarginal band, the abdominal border pale with some bluish-white hairs near the anal angle. Underside reddish brown; markings as above, the subapical band of spots continued in a curve (round the discal band) to the hinder angle; two whitish bands near the outer margin of fore wings, the outer one stopping short of the apex; a single white band near the outer margin of hind wings, both more or less macular; abdominal border and thorax tinged with blue; abdomen above with a bluish-white band near the base.

Expanse of wings $2\frac{3}{10}$ inches.

Perak. 3 ♂♂.

Nearest to *A. assa*, de Nicév. Journ. Bomb. N. H. Soc. 1894, p. 42, pl. K. fig. 8, which I have from the Battak Mountains, Sumatra: on the under side it is very similar; above it can at once be distinguished by the prominent bright orange apical spot.

6. *Athyma socia*, nov.

♀. Upperside black; markings pure white, the streak within the cell extending from base to end, divided into three

equal portions touching each other, thickens outwards and connects with a long spear-shaped mark beyond the cell with its point running into the lower end of a broad subapical band formed into three nearly square spots by the veins; an oblique discal band of three broadly oval spots in the three lower interspaces, a small white mark near apex, two pale lunulate lines or thin bands close to the outer margin: hind wings with a broad inner transverse band and a discal band of spots and a pale submarginal line as in *selenophora*. Underside pale brown with a rufous tinge, the base suffused with pale greenish scales, as is also the abdominal margin of the hind wings; the bands all very broad and the submarginal lines white and thick, and white spots on the margin: abdomen with a white band.

Expanse of wings $2\frac{7}{16}$ inches.

Solomon Islands. One example.

Belongs to the *selenophora* group, but it is quite distinct from that species.

7. *Cyrestis natta*, nov.

♂. Upperside with all the markings as in *C. cocles*, Fabr., but the basal half of both wings is sepia-coloured limited by the broad transverse pure white band; on the outer side of this band the ground-colour is also mostly sepia, the sinuous lines on each side of the row of ocelli being pure white; on the underside the transverse markings are sepia tinged with red.

Expanse of wings $2\frac{2}{10}$ inches.

Khasia Hills. Numerous examples.

In the 'Butterflies of India,' vol. ii. p. 254, Mr. de Nicéville refers this insect to *C. Earli*, Distant, under which name it stands in the Indian collections. Mr. de Nicéville says that *C. cocles* appears to usually present three distinct forms wherever it occurs; this is apparently a perfectly correct statement, but it only goes to prove the fact that if such forms are to be studied by the biologist and careful records kept of the manner in which they either die out or gradually establish themselves as good species, they must have names. In the Malay Peninsula we find three forms with three names—*cocles*, Fabr., *formosa*, Felder, and *Earli*, Distant. In India similarly we have three forms, but the third Indian form, whether it be only a form of *cocles* or a good species, is not the same as the third Malayan form; it differs widely from *Earli*, Distant, having much less white on it and is altogether of a different tint of sepia: they come in large numbers together from the Khasia Hills. I have examined many

hundreds and have now 72 *cocles* from India and Perak, 39 *natta* from India, and many *Earli* from Perak before me: some of the specimens of *natta* are paler than others, but I do not remember to have ever seen what might be called a real intergrade between this form and *cocles*; I have, however, never seen a female of *natta*, though females of *cocles* are not uncommon.

Fam. *Lycanidæ*.

8. *Tajuria teza*, nov.

♀. Upperside: fore wing blue, like the colour of *Oliaria othona*, Hew., but brighter and paler in the outer portions; the costal and outer margins broadly black, filling one third of the cell; the black band very broad beyond the cell, narrowing gradually towards the hinder angle, where it curves a little on the hinder margin; the blue portions irrorated with black atoms, thickly so on the inner half of the wing: hind wing darker blue; a blackish-brown costal border, inwardly diffuse, and the whole surface of the wing thickly irrorated with black atoms, suffusing the entire wing; marginal line black, inwardly edged with white; tails black with white tips; a blackish spot on the anal lobe, and a black spot at the end of the three next veins on the brown cilia. Underside bright chrome-yellow, with a discal narrow darker line outwardly edged with white: fore wing closed by a similar line; the discal line is somewhat irregular, like connected lunules, there is also an indistinct submarginal line not white-edged: hind wing with a similar discal band, nearly straight to the second medial nervure, then zigzag to the abdominal margin; a similar submarginal line with an outward white edging; marginal line black; the space between these lines and up half the margin white with black irrorations, with a chestnut spot in the first median interspace and a black spot in the anal lobe; cilia brown, edged with white.

Expanse of wings $1\frac{3}{10}$ inch.

Jaintia Hills. 2 ♀ ♀.

Above it much resembles the female of *T. istroidea*, de Nicév., but below the colour is quite different; the discal line on fore wings is also more irregular and the chestnut spot on the outer margin of hind wings below near the anal angle has not a black centre as it has in *istroidea*, and is close to the margin well inside the submarginal line; it also much resembles the female of *Tajuria thria*, de Nicév., from Sumatra and Burma*, but differs in the blue coloration of the upper surface and in the width and character of the black band.

* Journ. Bomb. N. H. Soc. p 181, pl. T. fig. 39.

Fam. Papilionidæ.

Subfam. *PIERINÆ*.

9. *Dercas enara*, nov.

♂. Larger than *D. brindaba*, the apical black patch running somewhat into the veins, instead of being nearly square cut as it is in *brindaba*; the inner margin of this patch is marked with bright orange colour, and so is the discal band, both characters wanting in the Indian form; no discal spot on the fore wings.

♀. Pale primrose, the apical patch more restricted, the pointed apex sometimes merely irrorated with black; the discal spot prominent as in the female of *Wallichii*.

Omei-shan, W. China. Many examples.

Mr. Leech in his 'Butterflies from China, Japan, and Corea,' p. 445, gives Doubleday's description of the male of *Wallichii* with the discal spot, but he figures (pl. xxxv. fig. 3) the form I now call *enara*. Perhaps a form with the black discal spot on the fore wing of the male does occur in China, but I have not seen it; all those received by me have been without it.

10. *Dercas brindaba*, nov.

♂. Like *D. Wallichii*, Doubl., but without the large blackish-brown spot in the interspace between the first and second median nervules of the fore wings above.

Khasia Hills. Numerous examples, all males.

This insect has been placed under the name of *D. urania*, Butler *, in all Indian collections; but *urania* is merely the female of *D. Wallichii*. I have received *D. brindaba* in great quantities from my Khasia Hill collectors during the past eight years; it always comes with *D. Wallichii* and is the commoner of the two. Though the discal spot in *Wallichii* is sometimes larger, sometimes smaller, it is never evanescent, and I think, therefore, I am justified in saying I have never seen an intergrade between the two; but whether it be a good species or merely a form of *Wallichii* it is very distinctive, and for the sake of convenience should have a name. I have never seen a female; it very probably closely resembles the female of *Wallichii*, as is the case with the allied Chinese form.

Fam. Hesperidæ.

11. *Hasora haslia*, nov.

♂. Upperside black, without markings: fore wings without the sex-mark. Underside dark brown, tinged with lilac,

* P. Z. S. 1865, p. 458, pl. xxvi. fig. 5.

without any gloss : fore wings with a deep black fascia in the central portion of the wing from the base to near the outer margin, running up to near the costa before the apex : hind wings with a very narrow pure white discal band from the costa before the apex to the abdominal margin above the anal angle, where it is broken ; anal angle filled up by a large blackish patch, slightly darker than the ground-colour of the wing ; cilia brown, with a basal pure white line for a short distance before the anal angle.

♀. Only differs from the male in having an ochreous sub-apical dot and two ochreous discal spots on the fore wings above, as in *Parata chromus*, Cram. ; below there is an additional white spot or patch near the hinder angle of the fore wings, in continuation of the discal white band of the hind wings.

Expanse of wings $2\frac{2}{10}$ inches.

Brisbane. 1 ♂, 5 ♀ ♀.

Received from my collector in Brisbane as *Parata chromus*, but it is a true *Hasora*, and not a *Parata*, and it is altogether differently coloured below and is much larger than *chromus*. It is unnamed in the B. M.

In vol. ix. p. 407 of the Journal of the Bombay Nat. Hist. Soc. Mr. de Nicéville says I use *Parata* in a generic sense while speaking of its subgeneric characters, which really means that I adopt the binomial and not the trinomial system ; apart from that, it is very difficult to my mind to determine the meaning of the words genus or subgenus. I do but agree with Dr. P. L. Scater, than whom there is no higher authority, who says * :—"Genera, as we all know, do not exist in nature, and it is a mere matter of convenience how large or how small we make them." How are we to define a genus ? Why should we ignore all secondary sexual characters in forming a genus ? I agree with Meyrick, who says † :—"There is absolutely no scientific justification for this restriction, which would make the classification of some groups of Lepidoptera quite impracticable ; when such structural characters are found in any instance to assist the definition of natural genera, there is no reason in nature why they should not be employed with perfect freedom."

Fam. Eupterotidæ.

12. *Eupterote crinita*, nov.

♂. Head, thorax, and fore wings dark olive-brown : fore wings crossed by many indistinct dark bands, the most

* 'Ibis,' 1897, p. 134.

† 'Handbook of British Lepidoptera,' p. 11.

distinct being a broad even discal band, with indications of a yellowish outer edging, followed by some yellow lunular marks, but the whole wing is so thickly clothed with long brown hairs as to make all the bands and markings very indistinct: the hind wings are still more thickly clothed with paler brown hairs over a yellow ground-colour, leaving an indistinct central broad brown band visible; a more prominent discal band, corresponding to the indistinct discal band of the fore wings, followed by a broad yellow band, which includes a row of dark brown spots with outward spear-shaped ends surrounded by yellow, and limiting the dark brown broad border. Underside pale yellow-brown; both wings with a thick central brown line, a similar discal line, black spear-shaped spots, and a darker marginal border.

Expanse of wings $3\frac{1}{2}$ inches.

Castle Rock, Karwar, Jan. 1892. Type in coll. Davidson.

Unlike any of the different forms of *Eupterote* yet described.

Fam. Notodontidæ.

Genus CLENORA, nov.

♂. Branches of the antennæ long, gradually shortening to the tips, which are simple, as in the genus *Rosama*, Walker: fore wings long and narrow; costa slightly concave before the middle, much rounded before the apex, which is also round; outer margin very oblique and angled at vein 3: hind wing with the anal angle much produced and extending almost to the extremity of the abdomen. Fore wing with vein 2 from middle of cell, 4 from end of cell, 3 at an equal distance between, 5 from centre of discocellulars (which are almost straight), 6 from upper angle of cell, 7, 8, and 9 stalked: hind wings with veins 3 and 4 and 6 and 7 from the angles of cell, 5 absent.

Looks superficially like a *Lasiocampa* allied to the genus *Ticerra*, Swinh., or *Bhima*, Moore.

13. *Clenora engonata*, nov.

♂. Antennæ, head, and collar ochreous; thorax and fore wings dark olive-green, sparsely irrorated with minute white scales, the veins whitish; apex, outer margin, and cilia chestnut-red: abdomen and hind wings chestnut-red, without markings. Underside with the pectus and legs ochreous; wings uniform chestnut-brown, with the apices and outer margins ochreous.

Expanse of wings $1\frac{1}{2}$ inch.

Karwar; rains, 1893. Type in coll. Davidson.

Allied to nothing I know of.

14. *Stauropus clothus*, nov.

♂. Head, thorax, and fore wings dark brown: fore wings with some white scales on inner and upper parts, a large white spot at end of cell, a similar white spot just beyond and slightly lower; three indistinct, outwardly curved, sinuous black lines—subbasal, antemedial, and postmedial—at equal distances apart, the last going through the white spots; a black streak on the hinder margin near the angle, four pale yellow points on the costa near the apex, and a submarginal row of black dots: hind wings pale brownish grey, slightly darker towards the outer margin: abdomen greyish brown.

Expanse of wings $1\frac{6}{10}$ inch.

Karwar, Sept. 1895. Type in coll. Davidson.

Fam. Geometridæ.

Subfam. *ENOCHROMINÆ*.15. *Sarcinodes perakaria*, nov.

♀. Upperside purplish cinereous; a double reddish line from apex of fore wings to abdominal margin of hind wings above the middle, as in *restitutaria*, Walker: fore wings with the space inside the double line saturated with dark chocolate colour, a large whitish spot at the end of the cell; hind wings with a darker discal indistinct fascia. Underside paler, suffused with brown on the outer portions; transverse line and discal dots as in *restitutaria*, but no signs of the upper discal black patch as in that species.

Expanse of wings $2\frac{7}{10}$ inches.

Perak. One example.

No doubt a local form of *S. restitutaria*, Wlk., this female having antennæ with short uniseriate branches as in that species; in *S. lilacina*, Moore, the antennæ of the female are quite simple, and therefore Hampson's diagnosis (Faun. Brit. Ind., Moths, vol. iii. p. 315), "antennæ with short uniseriate branches to two thirds length in both sexes," is not correct for this genus as a whole.

Fam. Limacodidæ.

16. *Narosa narcha*, nov.

♀. White, top of head, thorax, and fore wings suffused with pale reddish fuscous: in the fore wings the suffusion forming two indistinct bands, one from the base outwards, and the other from costa across the apical space, leaving the

apex white; a pure white spot at lower end of cell, a black mark in the outer margin above the angle; cilia interlined with pale fuscous: hind wings white, with some slight suffusion in the veins; cilia pure white. Underside white without markings.

Expanse of wings $1\frac{1}{10}$ inch.

Karwar, July 1895. Type in coll. Davidson.

17. *Thosea jasea*, nov.

♀. Head, body, and fore wings pale pinkish grey-brown, irrorated with very minute black atoms, without any markings: hind wings nearly black, without markings; cilia of both wings of the same colour as the wings, with a pale basal line. Underside: fore wings brownish grey, with pale prominent veins; hind wings whitish, being nearly completely covered with whitish irrorations.

Expanse of wings 1 inch.

Kutyne, N. Kanara, Jan. 1896. Type in coll. Davidson.

Like *T. Cotesi*, Swinh., smaller and paler, and absolutely without any markings.

Fam. Drepanulidæ.

18. *Euchera dictyaria*, nov.

♀. Above and below pure white; wings without any transverse markings: fore wings with the discal spot below showing through the wing; hind wing with a large black spot at the end of cell; both wings with a submarginal row of prominent round black spots, and a row of indistinct black dots between it and the margin; vertex of head black. Below with a large black spot at the end of the cell in both wings, and a row of submarginal black spots, smaller than they are above and not so round.

Expanse of wings $2\frac{1}{10}$ inches.

Kangra. One example. Type in coll. Davidson.

About the size of *E. Pitmani*, Moore, but more nearly allied to *E. substigmata*, Hübn.; the spots at the ends of the cells similar, but otherwise quite different.

Fam. Lymantriidæ.

19. *Topomesa lerwa*, nov.

♂. Head and shaft of antennæ reddish brown, branches of antennæ brownish grey; thorax and abdomen white, faintly tinged with pinkish: wings pinkish luteous; fore

wings the paler, a large brown lunular mark at the end of cell, costal line rufous, continued over the apex and on to the outer margin, where there is some rufous suffusion in the excised part below the apex; hind wings without markings, and more yellow in colour; cilia of both wings rufous. On the underside the body is whitish; legs rufous; the upper and outer portions of the fore wings and the whole of the hind wings, with the exception of the abdominal area, are suffused with bright rufous.

♀. With the fore wings suffused with olive-brown scales, darkest in the centre and outer margins, the outer margin angled at vein 4, and between it and the apex there is a deep excision; a large brown lunular mark at the end of cell. The underside is ochreous, the excision suffused with dark brown, the upper portions of fore wings and outer portions of hind wings with chestnut. The antennæ are almost as deeply pectinated as in the male; the head, thorax, and fore wings above are coloured as in the male.

Expanse of wings $1\frac{4}{5}$ inch.

♂. Castle Rock, Karwar, October 1892. ♀. Karwar, September 1895. Types in coll. Davidson.

20. *Cispia charma*, nov.

♂. Head, thorax, and abdomen orange; thorax with two black spots in front; antennæ black, the shaft white at sides: fore wings orange-grey; veins pale luteous, forming a pale spot at the lower end of cell; four black spots at the base: hind wings orange, without markings; cilia pale luteous. Underside of a uniform orange-colour, legs with black bands.

Expanse of wings 2 inches.

Karwar; rains, 1893. Type in coll. Davidson.

The hind wings are coloured as in *C. venosa*, Wlk., and *punctifascia*, Wlk.; the fore wings are greyer, the markings altogether different, and it is a much smaller insect.

Fam. Agaristidæ.

21. *Mimeusemia Davidsoni*, nov.

♂. Wings deep black: fore wings with a large pale yellow spot at one fourth from base, filling that portion of the cell and extending slightly below it, where it is slightly produced outwards; a broad pale yellow discal band from below the costa to the centre of the interno-median interspace, rounded at both ends and recurved opposite the lower end of the cell, beyond this is a band of metallic blue streaks

on the veins; some metallic blue scales in various parts of the wing forming three incomplete, irregular bands—subbasal, medial, and postmedial, the last being close along the inner side of the discal yellow band: hind wings as dark as the fore wings, but without any blue scales; a large central pale yellow spot joined to a pale yellow subbasal still larger patch, forming a broad band. Underside same as above, except that there are no metallic scales, and there is a subcostal yellow spot in the centre of the fore wings. Head, thorax, and abdomen black, the last four segments of the abdomen orange coloured.

Expanse of wings $1\frac{9}{10}$ inch.

Karwar, South Kanara. One example. Type in coll. Davidson.

Allied to *M. basalis*, Wlk., but the fore wing has no chestnut tinge, and the hind wing has a broad band instead of a central spot.

Fam. Lasiocampidæ.

22. *Lenodora fia*, nov.

♂. Pale reddish brown. Head, thorax, and abdomen covered with pale ochreous-brown hairs; anal tuft bright ochreous. Wings very thinly clothed, semihyaline: fore wings with the costa and hinder margin more thickly clothed with dark red-brown; a submarginal row of indistinct blackish spots; cilia bright red-brown: hind wings slightly more clothed than the fore wings; cilia bright red-brown. Underside: body and legs ochreous, covered with ochreous hairs; wings more ochreous, with the margins red-brown.

Expanse of wings $1\frac{1}{2}$ inch.

Kashmir, May 1896. Type in coll. Davidson.

Fam. Noctuidæ.

Subfam. *TRIFINÆ*.

23. *Acronycta iria*, nov.

♀. Head, thorax, and fore wings grey: fore wings with a longitudinal black streak below the middle, from near the base to about one third from base, where it stops and commences again from about one third from outer margin to near the margin; the wing is also crossed by an antemedial outwardly curved blackish sinuous line, a medial, short line from the costa to a black-ringed orbicular mark; an outwardly curved dentate black discal line, some indistinct submarginal

marks, and marginal black points which run into the cilia, which is whitish with blackish tips: hind wings greyish white, grey on the outer margins; veins dark grey; a thin discal transverse grey band: abdomen greyish white.

Expanse of wings 2 inches.

Kulu. One example.

Subfam. *ACONTINÆ*.

24. *Cosmia ozela*, nov.

♂ ♀. Frons white, top of head and collar chestnut-grey; thorax and abdomen brown, suffused with chestnut: fore wing with the suffusion forming a dark cloud on the centie of the hinder margin; costa with two small deep black spots, sub-basal and antemedial, then two large deep black spots, medial and subapical, between these two is a small whitish space; an indistinct brown discal sinuous line, outwardly curved on the upper part, deeply recurved to the lower end of cell, then downwards to the hinder margin one third from the angle; a blackish mark at the end of the cell: abdomen and hind wings brown without markings. Underside uniform dull brown; a brown dot at the end of each cell and a brown discal line across both wings.

Expanse of wings $1\frac{3}{4}$ inch.

Mhow. Type ♂ in coll. Swinhoe.

Karwar; rains, 1889. Type ♀ in coll. Davidson.

Subfam. *SAROTHRIPINÆ*.

25. *Ptisciana ioda*, nov.

♀. Palpi and top of head pinkish grey; thorax olive-brown; abdomen grey, with brown segmental bands: fore wings with the inner half brown, crossed by four or five dark brown lines; a yellow subbasal spot on the costa and another one third from base; the discal space is variegated, the upper part ochreous, the lower part smeared with white scales, the outer marginal part dark brown, in the ochreous part opposite the cell is a triangular black mark centred with ochreous, and this space is outwardly bounded by a duplex brown line, bent outwards round the triangular mark, a submarginal duplex line terminating at apex in a small white patch and a white spot in the disk; three ochreous dots on costa near apex: hind wings brown. Underside pale brown; costa of

fore wings with many whitish marks; hinder marginal parts and inner area of hind wings whitish; fore tarsi black with white bands.

Expanse of wings 1 inch.

Karwar, June 1895. Type in coll. Davidson.

Subfam. *CATOCALINÆ*.

26. *Catocala trisa*, nov.

♂. Palpi, head, thorax, and fore wings dark brown, thorax with a blackish stripe on each side: fore wings with sub-basal and antemedial, nearly erect, blackish bands, beyond this the wing is paler except towards the margin; two sinuous short black lines from the costa near the apex, across the apical space, enclosing a pale brownish ochreous apical spot, some spear-shaped black submarginal marks; cilia brown, with a pale line at their base: abdomen and hind wings bright ochreous yellow, a brown marginal band stopping abruptly at vein 2 and including a yellow apical space; cilia yellow. Underside: fore wings nearly white, hind wings yellow; fore wings with a short postmedial brown band, and a marginal brown band with an ochreous apical spot; hind wings with band as above, also with an ochreous apical spot.

Expanse of wings $1\frac{6}{10}$ inch.

Satara, 1874. Type in coll. Davidson.

Allied to *C. ochreipennis*, Butler, from Madagascar, but smaller and the wings narrower.

Subfam. *FOCILLINÆ*.

27. *Zethes ochrodes*, nov.

♂. Pale ochreous grey, with minute brown irrorations; thorax marked with black lines: fore wings with subbasal, outwardly curved, black line, another close to it nearly straight, curved inwards near the hinder margin, the third discal, from costa at two thirds, elbowed deeply outwards above the middle, then oblique to hinder margin at two thirds; two black longitudinal lines running just below the angle to the outer margin: hind wings with a straight medial line, a brown spot near anal angle outside the line, the outer portion of both wings slightly more irrorated than the inner; fore wing with a submarginal band of white lunules.

Expanse of wings $1\frac{1}{2}$ inch.

Port Blair, Andaman Islands. Two examples.

The lines are disposed much as in *Zethes* (*Rusicada*?) *basiscripta*, Wlk., but that insect has a black basal area.

28. *Iluzo noda*, nov.

♂. Antennæ black; palpi black at sides, inner parts and last joint ochreous; frons chestnut; thorax, abdomen, and both wings brown; top of head black, and a black band on thorax in front, from the costal base of one wing to the other: fore wings with a black lunule at the end of cell and a large black, almost quadrate, mark surrounded by a pale thin edging before the middle, extending from the median vein to the hinder margin: hind wings slightly paler towards the base, without markings. Underside: wings of a uniform pale brown, without markings; tibiæ with ochreous hairs, tarsi black, anal tuft of abdomen yellow.

Expanse of wings $1\frac{4}{6}$ inch.

Karwar, August 1895. Type in coll. Davidson.

The tibiæ are rather more hairy than usual and the palpi rather shorter. The insect somewhat resembles *Toxocampa*? *atriplaga*, Walker, from Natal, but it has the venation and other characteristics of the genus *Iluzo*, Walker, the type of which is *decisa*, Walker, which I have from the Jaintia Hills.

Fam. Thyrididæ.

29. *Hypolamprus rupina*, nov.

♀. Of a uniform pinkish-brown colour, with evenly disposed dark brown striations on both wings throughout; an indistinct large brown spot at the end of cell of fore wings: hind wing with the outer margin slightly excised before anal angle. Underside: fore wings paler, discal spot as above; hind wings whitish; brown striations on both wings as above.

Expanse of wings $1\frac{3}{6}$ inch.

Jarimpur, February 1895. Type in coll. Davidson.

XV.—*On the Localization of the Regenerative Surfaces in the Phasmidæ.* By EDMOND BORDAGE*.

AFTER a series of experiments I have succeeded in ascertaining that the regeneration of limbs in Phasמידs, in consequence of artificial amputation, only took place when the amputation had been performed in the region comprising the tarsus and the lower third of the tibia†; so that the only possible localities for the phenomena of regeneration were the region indicated and the surface of section corresponding to the line of fusion between the trochanter and femur, which was laid bare after autotomy. If there had been mutilations in the shape of amputations performed at different levels, the regenerative power would have manifested itself throughout the entire length of the limb, and would certainly have resulted in the reproduction of the whole of the missing portion, at whatever point these amputations had taken place.

I was therefore led to seek for the reason of such special localizations as these, and I have studied the manner in which the principal vertebrate enemies of *Monandroptera* and *Rhaphiderus* attack these insects and lay hold of them.

Birds, as I have been able to assure myself, are ill adapted to provoke autotomy or to mutilate the lower region of the limbs. They kill the insects immediately by dealing them repeated blows with their beaks. I have noticed this fact especially in connexion with the common myna (*Acridotheres tristis*), the great destroyer, *par excellence*, of grasshoppers and Phasמידs.

Lizards have yielded me more interesting results. I have observed the mode of procedure of the "bloodsucker" (*Calotes versicolor*) in order to seize a Phasמיד. The Orthopteron supports itself on its long bent legs, its body balanced in the strangest manner while walking, and even during repose, if the least breath of air makes itself felt. The abdomen is raised and bent back in a semicircle, an attitude which is especially remarkable in the young larvæ. It most frequently happens that the lizard, darting at the insect, seizes it by the abdomen or by the thorax and devours it

* Translated by E. E. Austen from the 'Comptes Rendus Hebdomadaires des Séances de la Société de Biologie,' t. v. no 28, 5 août, 1898, pp. 837-839: from a separate impression communicated by the Author. Cf. Ann. & Mag. Nat. Hist. ser. 6, vol. xi. (1897) pp 473, 476, and 507.

† *Vide* Bull. de la Soc. entomol. de France, séance du 13 juillet, 1898.

immediately. It is not so when the insect is a somewhat large one and is attacked by a *Calotes* of small size. In most cases the latter can only seize its prey by a limb. Then, by little abrupt and rapid movements, performed by relaxing a very little and then immediately tightening the grip of its jaws, which advance, so to speak, little by little, mounting up the limb, it finally reaches the body itself. I was never able to discover that its teeth severed the limb. They merely plant themselves more or less deeply in the chitinous sheath. The insect struggles and clings to the nearest objects by means of the claws with which the tarsi are terminated. This results in very severe strains on all the limbs, but especially on the leg which is seized. Not infrequently when the teeth reach the upper half or upper third* of the femur they may produce autotomy by breaking, if they penetrate deeply enough through the chitinous sheath. In certain cases, after having thus abandoned a limb, the insect, if upon a branch, allows itself to fall to the ground. In this manner it sometimes succeeds in hiding itself in the grass and in throwing its enemy off the scent. But in most cases it does not act thus, and confines itself to fleeing before the lizard. The latter speedily catches it up and renews its tactics, which in most instances end in the death of the Orthopteron.

When—which is of somewhat rare occurrence—the *Calotes* has only been able to seize the terminal extremity of the limb, the result, thanks to the relative fragility of this region, is the removal of a portion or of the whole of the tarsus, either by a pretty clean cut or by being pulled off. These mutilations must have contributed to the development of the regenerative faculty possessed by the tarsus and the lower third of the tibia; for the muscular fibres which move the joints of the tarsus have their attachments precisely in this portion of the tibia, and are subjected, beyond doubt, to strains and lesions, constituting a mode of excitation which is sufficient to explain the cases of regeneration exhibited by this lower third of the tibia.

We must not take any account of ants, whose bites can only provoke autotomy, and never mutilations of other kinds. The action of these bites is a purely *chemical* one, and could only have succeeded in manifesting itself at the outset of the period at which the special disposition which ensures spontaneous amputation had been subjected, in course of time, to

* The only region at which it is possible to provoke autotomy by cutting, pinching, or breaking.

a real process of improvement and had acquired a sufficient degree of sensitiveness. Moreover, ants only make their appearance during the tertiary epoch.

The perfecting process must likewise have been accelerated by the difficulty experienced by the larva in emerging from the egg-shell. At this time it frequently happens that the tarsus of one of the limbs remains fixed in the hard round shell, which is then dragged along like a ball by the insect. Severe strains result from this every moment, when the shell is caught in some obstacle. These strains, if not always sufficient to produce autotomy, nevertheless pretty often bring about the mutilation of the tarsus, which, after being torn off, is abandoned either in its entirety or else merely in part, together with the egg-shell. This, then, must again have contributed to the development of the regenerative faculty possessed by the tarsus and the lower third of the tibia.

Saurians and Batrachians, represented by the Stegocephali as early as the primary epoch, then certain small mammals beginning with the secondary epoch, although they do not appear to be able to produce mutilations in the shape of clean amputations of the femur and tibia, were nevertheless capable of contributing to the development of the regenerative faculty in the tarsal region, as well as to the perfecting of autotomy. But their attacks could not have been one of the primary causes of the appearance of the special disposition permitting autotomy first and regeneration afterwards.

In a communication shortly to appear I propose to seek for these primary causes.

MISCELLANEOUS.

Note on Papilio glycerion, Gray.

By F. A. HERRON, Assistant, British Museum (Natural History).

IN 1831 no. 1 of Gray's 'Zoological Miscellany' contained, on page 32, the short Latin diagnosis by Geo. Robert Gray printed below :—

"*Papilio Glycerion*.—*P. alis flavescens, fasciis nigris; posticis caudatis apice nigro, lunulis marginalibus cæruleis, angulo ani striga flava. Expansio alarum 3 poll. Habitat in Nepaul.*"

The original of the description is said to be in the collection of General Hardwicke.

Twelve years later—in 1843—Boisdual (Spec. Gén. Lép. i.

p. 247. n. 71) gave a full description of the upperside from a figure on a plate in Gray's then unpublished 'Lepidopterous Insects of Nepaul in the Collection of Major-General Hardwicke.' The plate is quoted by Boisduval as no. 1, but was published as no. 3. Most clear in the description is the notice of the two basal bands of the wings:—"La première, près de la base, se continuant sur le bord abdominal des inférieures; la seconde également commune, mais ne dépassant pas la cellule discoïdale des inférieures."

These bands are quite obvious in Gray's figures of *glycerion* in 'The Lepidopterous Insects of Nepaul' (1846).

In the interval, however, between Boisduval's description and the issue of Gray's plate, Westwood (Arcana Ent. ii. p. 24, t. 55. f. 3, 1843) had figured, under the name of *glycerion*, Gray, the underside of a *Papilio* which was not the species described by Gray and Boisduval, though he quotes the latter's detailed description as absolving him from figuring the upperside.

Westwood's specimen came from "Semlah, in the East Indies," and he received it from Captain Parry.

Oberthür, in 1879 (Et. d'Ent. iv. p. 115), described a Chinese form, entirely rightly, as *glycerion*, var. *mandarinus*; and in 1886 de Nicéville (Journ. As. Soc. Beng. lv. p. 254) described, as intermediate between *glycerion*, Gray, and *tmerianus*, Ob., *Papilio paphus* from Sikkim, and, for comparison, figured on pl. xi. *tom. cit.* the undersides of the species he called *glycerion*, Gray, and *paphus*, de Nicév.

Unfortunately *glycerion*, de Nicéville and of most authors, is *glycerion*, Westwood, nec Gray, as is obvious from the mention and figure of the median black line on the hind wings in the description of Boisduval and the drawing of Gray; and should further evidence be required, Gray's type is in the National Collection.

Papilio paphus, de Nicéville, became a synonym of *P. glycerion*, Gray, and *glycerion*, Westw. et auct. plur., was without a name till Rothschild's invaluable monograph on Eastern *Papilios* appeared in Novit. Zool. vol. ii. (1895), where the author bestowed the name *caschmirensis* on a subspecies, 165 (b), of what he, misled apparently by Westwood's error of identification, considered *glycerion*, Gray.

The subspecies 165 (a), "*Papilio glycerion*, forma *typica*" of the monograph, is still unnamed, and for this, the prevalent Sikkim form, I propose the subspecific name *sikkimica*.

The name of species no. 165 will be then *caschmirensis*, Rothschild, with subspecies *sikkimica*, mihi; and species no. 167 will stand as *glycerion*, Gray, with *mandarinus*, Ob., as a subspecies.

Paphus, de Nicév., being a synonym of *glycerion*, Gray, forma *typica*, disappears altogether.

The type of the genus *Pazala*, Moore (1888), is *Pap. glycerion*, Gray.

THE ANNALS

AND

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XVI.—*On the Origin of the Fauna of Celebes.*

By Professor Dr. MAX WEBER.

[THE following notes* are part of an article by Dr. Max Weber entitled "Die Süßwasserfische des Indischen Archipels," which appeared in his 'Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien,' vol. iii. 1894. In the first and special portion of the article complete lists of the freshwater fishes of Celebes and other islands are given, which are not reproduced here.]

IN dealing more closely with some questions of a general character, our starting-point is the opinion so clearly expressed by Dr. Günther † :—"The freshwater fishes being limited to the river- or lake-systems which they inhabit, and being less exposed to the disturbance affecting the terrestrial animals, are singularly adapted for the elucidation of the original geographical distribution of animals of the present creation."

* Translated by Miss Ethel S. Barton.

† Cat. Fish. viii. p. ix.

1. WHAT DIFFERENCES ARE EXHIBITED BETWEEN THE EASTERN AND WESTERN PORTIONS OF THE ARCHIPELAGO, AS REGARDS THE FRESHWATER FISHES?

The comparison of Sumatra, Borneo, and Java, on the one hand, with Celebes, Flores, &c. (in short, those islands lying to the east of the larger ones), on the other, shows at once a marked falling off in the number of species of freshwater fishes.

One is, perhaps, at first inclined to explain this fact by the smaller size of the individual islands in the eastern, as compared with the western, portion of the Archipelago. The area of fresh water, both rivers and lakes, must, of course, from the nature of things, bear a certain proportion to the size of the island. The smaller island will possess, on the whole, a less developed and less extensive river-system, and thereby be less adapted for the formation of a rich fish-fauna. Further, the form of the island and the disposition of its mountains have a proportionate influence. A glance at the map shows, for instance, that Flores can possess only very small insignificant rivers, and that also in Java, or on the east [? west—*Translator*] coast of Sumatra, the rivers can attain to only a small degree of development.

The size and configuration of the island, with the concurrent formation of rivers and lakes, are factors which must be taken into account in considering the peculiarities of the interesting fish-fauna of fresh water. These present, however, no satisfactory explanation of the above-mentioned decrease in the number of species of freshwater fishes in the eastern portion of the Archipelago. This may be at once seen in the case of Celebes as compared with Java. Celebes has an area of 178,833 square kilom., while Java has 125,896 square kilom.; and the opportunities for the formation of a freshwater fauna under present conditions are no less favourable than in Java. As a proof of this I would point out the river-system of the Tjenrana, in the south-west peninsula of Celebes, concerning the extent of which there exist careful estimates by A. Wichmann*; and I myself was able to collect here more or less extensively. According to Wichmann, the river-system of the Tjenrana embraces an

* A. Wichmann, "Die Binnenseen von Celebes," in Petermann's Mitth. 1893, Heft. x, xi, and xii. Compare also A. Wichmann, "Bericht üb. eine Reise im Ind. Archipel," in Tijdschr. Koninklijk Nederlandsch Aardrijkskundig Genootschap, 1890, pp. 47-49, and idem, 1892, pp. 299, 300.

area of 6065 square kilom., since it takes up the rivers Lapa-Lupa (La-Palupa), called in its upper waters Walannaë, as well as the Minralang and others. To the Tjenrana system belong also the freshwater lakes Tempe and Sidenreng, the latter covering 65 square kilometres.

So extensive a river-system can but be conducive to the development of a freshwater fauna. When, notwithstanding, the freshwater fish-fauna of Celebes is poor in species (though not in individuals), then the cause must lie in some other direction. This has been already recognized by von Martens and, as we shall see later, by Günther.

It might be thought that the present conditions are only of comparatively recent date, and that formerly, from a different configuration of the island, the river-systems reached only a small degree of development. This brings us to a region outside purely zoological considerations, which we must nevertheless refer to later. At the same time emphasis must be laid on the fact that another difference exists, more important than the actual decrease in the number of species, between the east and west portions of the Archipelago.

This difference is most clearly to be seen by a comparison of tables showing the occurrence of such fish in the Indian Archipelago as are undoubtedly freshwater. The following figures give the number of species of the different families on the three large Sunda Islands, as well as on Celebes, Flores, and Timor. Billiton and Madura are included in this enumeration, as well as Bali, which must not be omitted.

	Sumatra.	Borneo.	Billiton.	Java.	Madura.	Bali.	Flores.	Timor.	Celebes.
Siluridæ	64	68	4	45	5	1	0	0	0
Cyprinidæ	84	83	4	63	0	2	0	0	0
Cyprinodontidæ*.....	1	1	0	2	0	0	0	0	1
Osteoglossidæ	1	1	0	0	0	0	0	0	0
Nandidæ	3	3	2	1	0	0	0	0	0
Luciocephalidæ	1	1	1	0	0	0	0	0	0
Mastacembelidæ	5	5	1	3	0	0	0	0	0
Ophiocephalidæ	9	11	2	4 (5)	3	0	1	0	1
Labyrinthici	8	9	1	8	3	2	0	1	1 (2)

* The Cyprinodontidæ, although consisting largely of brackish-water forms, are here included under true freshwater fishes, since the genus *Haplochilus* belongs entirely to fresh water.

From this Table it may be seen that east of Borneo and Java the Mastacembelidæ, Siluridæ, Cyprinidæ, Nandidæ, Luciocephalidæ, and Osteoglossidæ are entirely wanting. In our earlier list of freshwater fishes existing in Celebes, the Siluride genera *Plotosus* and *Arius* were given. These were never found, however, in the interior, but only in the neighbourhood of river-estuaries; and, what is more important, they are equally at home in brackish water or in the sea. They do not therefore come under consideration here, where we are dealing exclusively with true freshwater fishes. Further, it is also worthy of notice that along the southern chain of the islands the transition is not so sudden as between Borneo and Celebes. The above Table shows us that already in Java the Luciocephalidæ, Nandidæ, and Osteoglossidæ are wanting, while Bali, so far as we know at present, only possesses two of the Cyprinidæ and one of the Siluridæ. Were we inclined to continue the boundary-line in the usual way between Bali and Lombok, that boundary-line which, for freshwater fishes also, almost completely separates Borneo from Celebes, we should have to bear in mind our complete ignorance of the freshwater fauna of Lombok. Supposing for the moment that the conditions in Lombok were the same as those in the more eastern islands—Sumbawa, Flores, &c.—this boundary-line would have little to mark off. At the best, so far as our present knowledge goes, there would be on the one side Bali, with two Cyprinidæ and one Siluridæ, while on the other—the eastern side—neither is represented. The difference, in itself unimportant, becomes still smaller when we examine how matters stand in Celebes as regards the Ophiocephalidæ and Labyrinthici, equally characteristic of the western portion of the Archipelago. Sumatra has nine, Borneo eleven, Java only four species of *Ophiocephalus*; not one is recorded from Bali; but Celebes, Flores, even Amboina still have *Ophiocephalus striatus*. This startling fact was recognized by Bleeker and v. Martens for Celebes and Amboina. v. Martens believed it was possible that this fish, characteristic of the Indian fauna, had been introduced by man; but against this is to be placed its widespread occurrence in Celebes, even in places where the population has not reached such an advanced state of civilization as to allow the probability of such an introduction. This objection holds good in a still more marked degree for Flores, where I also found this species in a small stream unsuitable for the cultivation of fish. Besides this, the inhabitants of Flores are of a low type and seldom fish. Finally, as regards the Labyrinthici, of the nine (or

eight) species recorded from Sumatra, Borneo, and Java, Bali possesses only two—*Osphromenus trichopterus* and *Anabas scandens*. The latter occurs on Sumbawa, Celebes, Rotti, Sumba, and Timor *, but in such a manner as to preclude the idea of introduction by man.

The question, therefore, as to the differences existing between the eastern and western portions of the archipelago as regards freshwater fishes may be answered thus :—

1. The transition from Borneo to Celebes in respect of river-fishes is very abrupt. Out of the nine families of freshwater fishes characteristic of the Oriental region only three occur in Celebes, each represented by one species, while, according to our present knowledge, Borneo has 182 species. The Cyprinidæ and freshwater Siluridæ, which are so well represented in Borneo, are entirely wanting. This want is not explained by the present hydrographical condition of Celebes.

2. Since Siluridæ (one species) and Cyprinidæ (two species) are found in Bali, and not in those islands further to the east (which fact would argue their non-occurrence in Lombok, hitherto unexplored ichthyologically), this would coincide with the original Wallace line. But it must not be forgotten that already in Java there is a decrease in freshwater fishes, not only with respect to the number of species in proportion to the smaller size of Java compared with Borneo and Sumatra, but also qualitatively, inasmuch as two families—the Osteoglossidæ and Luciocephalidæ—are wanting in Java. In Bali six out of the nine families given in our tables no longer occur †.

2. WHAT IS THE ORIGIN OF THE FRESHWATER FISH-FAUNA IN THE EASTERN PORTION OF THE ARCHIPELAGO?

Since we have shown that the islands to the east of the great Sunda group are almost entirely wanting in true freshwater fishes, the question arises, What is the origin of the fish-fauna on these islands? An inspection of the tables for Celebes and Amboina, although dealing with a much richer material, gives the same result as Ed. v. Martens ‡

* According to Bleeker, Amboina has a peculiar form—*Anabas microcephalus*, Blkr.

† Probably, however, *Ophiocephalus striatus* and a species of *Haplochilus* occur in Bali.

‡ Ed. v. Martens, 'Preuss. Expedition nach Ost-Asien, Zoolog. Theil, Bd. i. 1874, p. 313.

arrived at in his excellent explanation of the fauna of the Indian Archipelago twenty years ago. This author writes:—"In Celebes begins a far greater poverty in freshwater fishes, inasmuch as from here onwards the true freshwater species are wanting throughout the whole eastern portion of the Archipelago. . . . It is therefore principally those genera regarded above as consisting of migratory and brackish-water fishes, such as eels, several Percoidæ, and some Gobioidæ, which form the freshwater fauna in Celebes and the Moluccas, several species of which appear only to have been found in fresh water . . . while the majority live also in the sea or at least in brackish water. . . . The very poor development of the freshwater fauna in the eastern half of the Archipelago arises partly from the fact that hardly anything but small rivers or streams exist, with stony bottom and varying depth; for Celebes, however, this explanation does not hold good, since the lake of Tondano, for instance, contains a considerable mass of water, in which Cyprinidæ and Siluridæ could feel quite at home. In the absence of these two families of freshwater fishes, the eastern portion of the Archipelago agrees with its eastern and southern neighbours, Australia and the small islands of the Pacific."

As I have said, my much richer material only confirms this statement. This may be shortly explained by the conditions offered by Celebes. I select this island advisedly, because it possesses the most favourable hydrographical conditions for the cultivation of a freshwater fauna, and also because this fauna is much richer on Celebes than on the other islands in the eastern portion of the Archipelago. Another point in selecting Celebes for consideration lies in the peculiar position which it occupies in many respects, and this accounts for the interest long shown in this island by many investigators.

The Table in the original memoir shows that Celebes has at least fifty species of fishes in true fresh water; the numerous other species given in the same Table, which up to the present have only been recorded from the river-estuaries, are not considered here. Of these fifty species there are only twenty-five which are not recorded also from the sea or brackish water; these are:—

Dules rupestris, C. V.
Therapon micranthus, Blkr.
Toxotes jaculator, Pall.
Gobius bicirrhosus, M. Web.
 — *biocellatus*, C. V.
 — *grammepomus*, Blkr.

Gobius lacrymosus, Pet.
Sicydium cynocephalum, C. V.
 — *microcephalum*, Blkr.
Platyptera aspro, C. V.
Agonostoma plicatile, C. V.
 — *oxyrhynchum*, C. V.

<i>Ophiocephalus striatus</i> , <i>Bl.</i>	<i>Symbranchus bengalensis</i> , <i>M. Clell.</i>
<i>Anabas scandens</i> , <i>Dald.</i>	<i>Anguilla mauritiana</i> , <i>Benn.</i>
? — <i>oligolepis</i> , <i>Blkr.</i>	— <i>sidat</i> , <i>Blkr.</i>
<i>Haplochilus celebensis</i> , <i>M. Web.</i>	<i>Ophichthys Kaupi</i> , <i>Blkr.</i>
<i>Hemiramphus orientalis</i> , <i>M. Web.</i>	<i>Doryichthys caudatus</i> , <i>Pet.</i>
? <i>Notopterus kaporat</i> , <i>Lac.</i>	<i>Tetrodon erythrotænia</i> , <i>Blkr.</i>
<i>Monopterus javanensis</i> , <i>Lac.</i>	

This great poverty in the fish-fauna of fresh water in Celebes and its marine character cannot be explained by the present hydrographical condition of the island.

3. HAS THE FISH-FAUNA OF CELEBES AN AUSTRALIAN CHARACTER?

In his invaluable 'Handbook of Ichthyology' Günther divides the equatorial zone, in respect to the distribution of freshwater fishes, into a Cyprinoid and an Acyprinoid region. In the Acyprinoid he includes the tropical American and tropical Pacific regions, characterizing the latter by the presence of Dipnoi, while, in contradistinction to the Indian region, the Cyprinidæ and Labyrinthici are absent. "This tropical Pacific region embraces all islands to the east of Wallace's line, New Guinea, Australia (with the exception of its south-eastern portion), and all islands in the tropical Pacific as far as the Sandwich group." The importance of Günther's views on this question is so great that we will quote further from him:—"Comparing the area of this region with that of the others, we find it to be not only the poorest in point of the number of its species generally, but also in that of the possession of peculiar forms." Then follows a short list, after which he says, "The paucity of freshwater fishes is due in the first place to the arid climate and the deficiency of water in the Australian continent, as well as to the insignificant size of the freshwater courses in the smaller islands. Still this cannot be the only cause; the large island of Celebes, which by its mountainous portions, as well as by its extensive plains and lowlands, would seem to offer a favourable variety of conditions for the development of a freshwater fauna, is, so far as has been ascertained, tenanted by seven species of freshwater fishes only, namely, two *Arius*, two *Plotosus*, one *Anabas*, one *Ophiocephalus*, and one *Monopterus*, all of which are the commonest species of the Indian region. . . . Finding, then, that even those parts of this region which are favourable to the development of freshwater fishes have not produced any distinct forms, and that the few species which inhabit them are unchanged or but slightly

modified Indian species, we must conclude that the whole of this area has remained geologically isolated from the other regions of this zone since the commencement of the existence of Teleostei, and that, with the exception of *Ceratodus* and *Osteoglossum*, the immigration of the other species is of very recent date."

To this statement we may be permitted to add the following remarks:—Firstly, the fish-fauna of Celebes is somewhat different from what Günther was aware of at that time. This has been explained at length above. *Arius* and *Plotosus* are unquestionably forms which have wandered in from the sea, and belong only to the river-estuaries.

As touching the further agreement with the fish-fauna of Australia, I have drawn up, in answer to this question, a list of Australian fishes. Although this may be incomplete, it will nevertheless represent the character of this fish-fauna. Only those genera are given here which have been recorded from the tropical regions of Australia:—

Pseudolates.	Oligorus.	Plotosus.
Lates.	Ctenolates.	Copidoglanis.
Psammoperca.	Dules.	Onidoglanis.
Serranus.	Therapon.	Eumeda.
Mesoprion.	Pristipoma.	Arius.
Ambassis.	Gerres.	Haplochiton.
Pseudambassis.	Toxotes.	Saurida.
Edelia.	Upenoides.	Galaxias.
Acanthoperca.	Chrysophrys.	Belone.
Apogon.	Lethrinus.	Osteoglossum.
Eleotris.	Centropogon.	Engraulis.
Aristeus.	Polynemus.	Chatoessus.
Atherinichthys.	Corvina.	Brisbania.
Mugil.	Caranx.	Clupea.
Agonostoma.	Psettes.	Elops.
Myxis.	Equula.	Megalops.
Chærops.	Sillago.	Anguilla.
Coris.	Gobius.	Conger.
Pseudorhombus.	Gobiodon.	Muraena.
Synaptura.	Periophthalmus.	Ostracion.
Apogonichthys.	Plagusia.	Ceratodus.
Gulliveria.		

From this list it may be seen that three elements go to form this fish-fauna:—

1. Marine immigrants, which belonged originally to the tropical Pacific, and could therefore penetrate into the rivers of all islands and countries washed by this ocean. They show nothing characteristic of the Australian fauna. Parallel or similar species are chiefly found in Australia and Celebes, for example, but they also occur in the rivers of the large

Sunda Islands. That they are, perhaps, less numerous in the latter locality I have already tried to explain by the fact that a given amount of water can only harbour a certain number of fishes. The western islands possess fishes peculiar to their rivers, and these are wanting in the eastern islands, where a more abundant immigration is rendered possible.

2. True freshwater fishes, which also belong to the Oriental region. We may cite *Dules*, *Haplochiton*, and, if we go further, *Toxotes*, *Gobius*, *Eleotris*, *Agonostoma*, *Anguilla*.

3. True freshwater fishes, which are absent from the Indian Archipelago, east of the "Wallace line." These are *Ceratodus*, *Osteoglossum*, *Oligorus*, *Galaxias*.

With the exception of *Osteoglossum*, which occurs in Borneo and Sumatra, it is just these fish characteristic of Australia that are absent both east and west of the "Wallace line." The similarity of the freshwater fishes of Australia and Celebes rests therefore on the following points:—

1. The Cyprinidæ, Mastacembelidæ, Nandoidæ, belonging to the Oriental region, are absent.

2. Siluridæ are represented only by marine immigrants.

3. Numerous marine forms inhabit the fresh water.

There are, however, considerable differences:—

1. *Ceratodus*, *Osteoglossum*, *Oligorus*, *Galaxias*, forms characteristic of Australia, are absent.

2. On the other hand, Celebes has certain genera belonging to the Indian region which are wanting in Australia—*Anabas*, *Ophiocephalus*, *Symbranchus*, *Monopterus*.

Opposed to these positive differences there remains a similarity in negative characters, which rests on an absence of a number of Indian forms in Celebes as well as in Australia. It may be expressed thus:—Australia and Celebes agree in poverty of freshwater fishes; Australia has some forms peculiar to itself which do not occur in Celebes; on the other hand, Celebes possesses some forms which belong to the Indian region and do not occur in Australia. Thus the character of the fish-fauna of Celebes is not Australian, but Indian, and that in a high degree impoverished.

4. HOW CAN THE FISH-FAUNA OF CELEBES BE EXPLAINED?

From the foregoing statements it may be seen that the freshwater fauna of Celebes is principally recruited by immigration from the sea, and that only isolated representatives of true freshwater fishes (*Ophiocephalus striatus*, Bl., *Anabas scandens*, Dald., *Haplochilus celebensis*, M. Web., *Monopterus javanensis*, Lac., *Symbranchus bengalensis*, M'Clell.) are

found there. These belong to the Oriental region. Indigenous forms do not occur (for *Haplochilus celebensis* cannot be considered such), nor *Ceratodus* and *Osteoglossum*, which belong to the tropical region of Australia, the latter being found also in the great Sunda Islands. From this we receive the impression that the entire area of fresh water, poor in freshwater forms, was gradually peopled from the sea.

How is this dearth to be explained, since it is not occasioned by the present hydrographical condition of Celebes?

Further, how is the qualitative difference in the fish-fauna of Celebes to be explained as compared with that of the large Sunda Islands?

The answer to the first question would be that the present hydrographical conditions were not necessarily those of the past. There are geological proofs that the shape of Celebes was formerly different from what it is to-day, and we are indebted to A. Wichmann for this important information. He shows that South Celebes (which is of special importance to us, as containing the system of the Tjenrana River specially in question) consisted in the second half of the Tertiary period (Neogen) of a number of small separate portions, rising like islands above the surface of the sea *. "In consequence of the negative elevation, which began at the end of the Neogen and continues to this day, the island of South Celebes was uplifted to form a peninsula through junction with the central mass of the island, while at the same time the surrounding coral-islands were raised and the sandstone-beds in the east rose from the sea as eroded surfaces" †.

From a geological point of view it is also probable that the connexion between North and South Celebes is comparatively recent. In a former article ‡ I pointed out the peculiar differences in the mammalian fauna of North and South Celebes. In South Celebes *Paradoxurus Musschenbroekii*, Schl., *Babirusa alfurus*, Less., *Cynopithecus niger*, Desm., *Sciurus murinus*, Müll. & Schleg., *Sciurus rubriventer*, Müll. & Schleg., *Sciurus leucomus*, Müll. & Schleg., *Sciurus Prevosti*, Desm., which up to the present have only been recorded from North Celebes, are absent. On the other hand, *Macacus maurus*, Cuv., *Sciurus notatus*, Boddaert, *Sciurus Weberi*, Jentink, are peculiar to South Celebes.

* A. Wichmann, "Bericht üb. eine im Jahre 1888-89 ausgeführte Reise nach d. Ind. Archipel," Th. i. p. 74, in Tijdschr. v. h. Nederl. Aardrijkskdg. Genootschap, Jaargang 1890.

† A. Wichmann, "Die Binnenseen von Celebes," Peterm. Mitth. 1893, Heft. x., xi., and xii. p. 18 des sep. Abdruckes.

‡ Max Weber, Zoolog. Ergebnisse, Bd. i. 1890-91, pp. 103, 110, 113.

Here we are dealing in part with large mammals. This difference between North and South is all the more marked that the number of mammals of Celebes is in any case not large. Still more marked are the differences between the land-snails of North and South Celebes. According to the statements of Ed. v. Martens* only sixty-four species had been recorded up to 1891, and of these only two are common to North and South, "namely *Trochomorpha planorbis*, which is distributed over the other large islands, and *Amphidromus perversus*, which occurs in Borneo; as a third there may perhaps be reckoned *Nanina limbifera*, which is, of course, characteristic of Celebes. . . ." Twenty-seven species are so far exclusively peculiar to the northern peninsula and thirty-one to the south-west. Three species are recorded only from the south-east peninsula and two species from both southern peninsulas. This interesting and remarkable difference in the fauna can be explained only by a former separation of the two regions. The junction of these regions since the Neogen period could not have sufficed to counteract the difference as regards the sluggish land-snails, which are not easily transported, and this difference is still evident among active mammals. Even among birds it is not yet eliminated. But it can hardly hold good for the freshwater fishes, since these are all of marine origin, and being equally distributed by the sea can penetrate into the most different river-systems.

If now, both from zoological and geological standpoints, important reasons exist for the acceptance of the theory that Celebes consisted formerly of several unconnected islands; if, further, geology makes it probable that this was the case during the second half of the Tertiary period; then it follows that the present rivers are of recent date, and the small size of the islands previously prohibited the formation of river-systems of any considerable size. Thus we see that the group which we now call Celebes was, in the second half of the Tertiary period, altogether unfitted for the production of a fauna of freshwater fishes. This would seem to me to explain the peculiarities of the fish-fauna of Celebes more satisfactorily than the theory that Celebes was separated from the Indian continent before it could have been peopled with Cyprinidæ and Siluridæ, for the simple reason that these genera had not yet appeared on the earth. This, however, seems to be Günther's view, if I am not mistaken. Asst on see, in his statement quoted above at length, he ends with marked

* E. von Martens, "Landschnecken des Indischen Archnd of this Max Weber, Zoolog. Ergebnisse &c. Bd. ii. 1892, p. 259. A out of the slipped in among the numbers of the species in North and Soring islands, Austral-

words "we must conclude that the whole of this area (the tropical Pacific region) has remained geologically isolated from the other regions of this zone since the commencement of the existence of Teleostei." As a zoologist one will readily agree with the view of this distinguished ichthyologist that Australia was at one time separated from Asia, when the Teleostei first appeared, so that only one of the oldest types—*Osteoglossum*—could occur there and in the Malay Archipelago. But for Celebes, according to the present state of our knowledge, such an explanation no longer seems to be correct.

The separation of Celebes from the Asiatic continent can only have taken place after the immigration of *Anoa depressicornis*, *Babirussa alfurus*, *Cynopithecus niger*, *Macacus maurus*, *Paradoxurus*, *Sciurus*, *Tarsius*, and other Indian forms. Even if the preservation of single species among these (*Anoa*, *Babirussa*, *Cynopithecus*, *Macacus maurus*) as solitary specimens in Celebes is taken as a sign of their great age, they still cannot be older than Siluridæ and Cyprinidæ. If, notwithstanding, the Indian river-fishes did not take part in the immigration of the Indian mammals, then it was probably because the hydrographical condition did not favour such immigration. It must also be remembered that in those early Tertiary times Cyprinidæ and Siluridæ had not yet such a wealth of species as has since been developed.

We grant therefore to Celebes a longer connexion with the Asiatic continent than was allotted to Australia. The poverty in freshwater fishes in Australia and Celebes has a different cause. Australia was separated from the Asiatic continent as far back as the first appearance of Teleostei; Celebes, on the other hand, was separated later, when Cyprinidæ and Siluridæ had already appeared, though still sparingly. In consequence of its splitting up into small islands it did not, however, offer the hydrographical conditions necessary for the reception and development of a freshwater fauna.

If my investigations have become more and more concentrated on Celebes, this has arisen because the fauna of Celebes has already been so often a subject of discussion, and because Celebes is in many respects a prototype of the other eastern islands. This does not mean that the conditions are exactly the same for Flores, Timor, and Amboina as for Celebes. On the contrary, the age of these islands is entirely different, as is their fauna; but for the fish-fauna of the above-named islands the same conditions obtain, except that Celebes has the advantage of a greater area of fresh water. Towards the fish-fauna, we came to the conclusion that

that of Celebes has an impoverished Indian, not an Australian, character. This, in the main, is also to be seen throughout the other animal groups in Celebes, where the Australian character is very slightly perceptible.

Land-molluscs are, of course, very important in questions of zoogeography. We therefore refer to the very clear statement of E. v. Martens*, who is probably the greatest authority on this subject. We will only quote the following:—"The land-snails of Borneo and those of Celebes are still sufficiently dissimilar, notwithstanding two species in common, to allow of the boundary-line being drawn here; but North Celebes is not easily separated as regards its land-snails from the Philippines, which are, however, placed by Wallace on the Indian side. Rather less startling is the difference between Java on the one side and Flores and Timor on the other; the special novelty characteristic of the East—the *Xesta* group of *Naninae*—is found on the island of Bali, which Wallace places on the Indian side. Finally, as regards land-snails there is absolutely no unity between Celebes, the Moluccas, Flores, Timor, New Guinea, Australia, and the countless islands of the Pacific; no single genus or subgenus of land-snails is common only to these and unrepresented in other parts of the world; even the Moluccas on the one hand and Flores and Timor on the other are more dissimilar than Sumatra, Borneo, and Java. . . ."

If we turn to the mammals, which play a prominent part in such questions, we find that here also the "Australian character" of Celebes rests only on the inaccurate knowledge of actual conditions possessed by authors who have given expression to the above view. The unhappy "Wallace line," which Wallace himself did not retain for Celebes, has penetrated as something fascinatingly simple into the brains of numerous zoologists. Text-books, which dismiss zoogeography with a few words, do not allow this classical line of demarcation to escape them. Thus the "Australian" fauna of Celebes continues to exist in spite of various protests†.

* E. v. Martens, in Max Weber, Zool. Ergebnisse, Bd. ii. 1892, p. 263.

† To name only a few writers who have expressed themselves according to this view, we may indicate E. Hæckel, "Zur Phylogenie d. austral. Fauna," in Semon, Zoolog. Forschungsreisen in Australien u. d. Malayischen Archipel (Jena, 1893). We read there:—"At no other point on the earth are there found two neighbouring faunal regions in such marked contrast as on the narrow boundary between the Indo-Malay and Austral-Malay region. If we traverse the narrow strait at the south end of this boundary-line—the deep Lombok Strait—we step at once out of the present into Mesozoic times. Although the two neighbouring islands,

If we exclude the Chiroptera, Celebes has the following land-mammals:—

Cynopithecus niger, *Desm.*
Macacus maurus, *F. Cuv.*
Cerocebus cynomolgus, *Schreb.*
Tarsius fuscimanus, *Fisch.*
Sciurus murinus, *Müll. & Schl.*
 — *rubiventer*, *Müll. & Schl.*
 — *leucomus*, *Müll. & Schl.*
 — *Prevosti*, *Desm.*
 — *notatus*, *Bodd.*
 — *Weberi*, *Jent.*
Acanthion javanicum, *F. Cuv.*
Mus Beccarii, *Jent.*
 — *Musschenbroekii*, *Jent.*
 — *xanthurus*, *Gray.*
 — *Hellwaldii*, *Jent.*
 — *callithrichus*, *Jent.*

Mus Meyeri, *Jent.*
 — *Faberi*, *Jent.*
 — *decumanus*, *Pall.*
 — *rattus*, *L.*
 — *celebensis*, *Gray.*
Echiotrix leucura, *Gray.*
Paradoxurus Musschenbroekii,
Schl.
Viverra tangalunga, *Gray.*
Anoa depressicornis, *Smith.*
Sus celebensis, *Müll.*
Babirusa alfurus, *Less.*
Russa russa, *Müll.*
Phalanger celebensis, *Gray.*
 — *ursinus*, *Temm.*

If we include the island of Sanghi, in very close proximity to Celebes, as well as the Saleyer group, there are the following additions:—

Sciurus Rosenbergi, *Jent.* *Phalanger maculatus*, *St.-Hil.*
Paradoxurus musanga, *Gray.*

Bali and Lombok, are only a few miles apart, and are subject to the same climatic conditions, the land-fauna characteristic of each is quite different; and still more is this the case when we cross the Macassar Strait from the Indian Borneo to the Australian Celebes. The decided contrast in the birds and mammals of each is so great that it must be reckoned as one of the most striking chorological arguments of Transformismus" ("schlagendsten chorologischen Argumenten des Transformismus"). Hæckel ('Schöpfung der Thier,' 1893, p. 238) is of the same opinion, and does his utmost to make the mammal-fauna of Celebes "and those islands which together with it form a group" an Australian one. The stag and the civet-cat were introduced by man into Celebes, perhaps also the pig (*Sus celebensis*); "it may, of course, have had an opportunity of swimming across the arms of the sea and of developing in Celebes into a peculiar species, while the squirrels and the Tarsii have possibly also reached Celebes on drift-wood . . . the crested baboon, the Indian hog, and the Anoa, probably ancient forms, which Celebes obtained when it was still connected with the Indian region, thereby offering opportunity for the immigration of certain animals which have since died out in India." Thus, while some Indian mammals have been imported, and *Sus celebensis*, six species of squirrels, and *Tarsius fuscimanus* have either swum or been drifted across, and the mice (of which there are about twelve species unconnected with Australian mice) "are descendants of former Australian species," there remain three species of Phalanger, the only animals, as the author himself confesses, peculiar to the Australian region. One asks with astonishment why Phalangiers did not come to Celebes on drift-wood, since they are splendid climbers, can cling tightly to trees, and are very tenacious of life. Still more astonishing is it that an author who writes about Celebes should know so little of its fauna that he quite forgets two apes (*Cercopithecus cynomolgus* and *Macacus maurus*) and two beasts of prey (*Paradoxurus musanga* and *P. Musschenbroekii*). These probably wandered over from India too when Celebes "was united to the Indian region."

According to this, the so-called Australian element consists of only three species, all belonging to the genus *Phalanger* (*Cuscus*), as opposed to thirty-one non-flying land-mammals, which unquestionably belong to the Oriental region. This genus *Phalanger*, of which only five species are known, has only one representative in Australia. The above conclusion therefore holds good for the Celebes mammal-fauna, namely, that it presents principally an impoverished Indian character. This fact, and the preservation in Celebes of certain ancient forms, indicate that the connexion with the Indian continent was much earlier severed than was the case with the large Sunda Islands.

But also in the southern chain of islands of the Archipelago the conditions are other than Hæckel believed when he maintained, probably relying on Wallace, that in passing from Bali to Lombok one steps out of an Indian fauna into Mesozoic times. One simply enters an impoverished Indian fauna, which impoverishment has already begun in Bali, as I have shown above, in dealing with the fishes. Since the land-molluscs have been already mentioned, I may add some remarks on the mammals. Some years ago Jentink * rightly pointed out that Wallace's statement—"Bali and Lombok differ far more from each other in their birds and quadrupeds than do England and Japan"—is entirely incorrect as regards mammals. Hardly anything is known of either island, except that on Lombok occur *Cercocebus cynomolgus*, Schreb., and *Tarsius spectrum*. In Flores, still further east, I have proved the occurrence of *Cercocebus cynomolgus*, Schreb., *Paradoxurus musanga*, Hodgs., *Mus decumanus*, Pall., *Mus d'Armandvillei*, Jent., *Mus Wichmanni*, Jent., *Acanthion javanicum*, Cuv., *Sus vittatus*, Müll., *Russa russa*, Müll.†

These are exclusively Indian forms. This Indian fauna is enriched if we note that *Tarsius fuscomanus*, Fisch., is recorded from the island of Savu (between Timor and Sunda), and a species of wild cat (*Felis megalotis*, Müll.) from Timor and Rotti. Altogether the mammal-fauna of Timor contains only one species which is not Indian, viz. a single species of *Phalanger*, all the rest belonging to the Oriental region.

The original boundary-line, as drawn by Wallace, therefore divides island-groups from each other, of which the western ones (Borneo, Sunda, and Java) have received a rich Oriental fauna, and have been able to evolve specific forms of an Indian character. This has arisen partly from their

* Jentink, in Tijdschr. v. h. Kon. Nederl. Aardrijkskundig Genootschap, 1889 (meer uitgebr. artikelen).

† Zool. Ergebnisse, Bd. iii. 1893, p. 260 et seq.

size, but principally through a prolonged connexion with the Indian continent.

Of those islands east of the boundary-line, Celebes was first cut off from the Indian mainland, and from that time has so remained. Hence it retained isolated ancient forms, which developed independently. Since it consisted from an early date of separate small islands, the fauna remained poor.

As regards the southern chain of islands (Bali, Lombok, Sumbawa, Flores, Timor, &c.), the impoverishment of the Indian fauna begins even in Bali. A sharp boundary between Bali and Lombok, which would have to rest on the evidence of various groups of animals, does not exist. Marsupials appear first in Timor, represented by one species of *Phalanger*. The above-mentioned southern chain of islands is therefore a zoogeographical representative of an earlier Java. To compare this chain with Celebes alone is inadmissible on account of the difference in their ages.

East of Celebes and Flores we come for the first time into a distinct transition region, where the Indian forms gradually retire and the Australian increase in number the further eastwards we go.

XVII.—*A Re-examination of Hutton's Types of New Zealand Earthworms.* By W. BLAXLAND BENHAM, D.Sc., M.A., Professor of Biology, University of Otago, Dunedin, New Zealand.

CAPTAIN HUTTON'S account of New Zealand earthworms was written some twenty years ago*, when the study of earthworms was only just engaging the attention of Perrier, and at a time when even the specific characters of the common British earthworms were absolutely neglected by English zoologists, in spite of the careful accounts by Dugès, at a time when there was practically no literature dealing with exotic genera except the papers which are buried in periodicals which were to be found only in the larger libraries; it is not surprising, therefore, that the descriptions should be vague, imperfect, and almost useless. Those of us who have made a study of earthworms have long recognized that Hutton's genera, in which he places the species, are

* "On the New Zealand Earthworms in the Otago Museum," Trans. New Zealand Institute, vol. ix. 1876, p. 350.

incorrect; and since Beddard's series of papers upon the New Zealand worms it has become a certainty that most of Hutton's species belong in all probability to Acanthodrilid genera.

Consequently, soon after my arrival in Dunedin, I took the opportunity of examining the "types," which I discovered in a storeroom in the Otago Museum.

Hutton described six species, of which he placed four in the genus *Lumbricus* and two in *Megascolex*. In a subsequent paper* he suggested that *L. uliginosus* belongs to *Acanthodrilus*, and some of the species of the former genus were probably members of the genus "*Digaster*," though upon what ground it is difficult to say. As will be seen from the following account, Hutton has sometimes confused two or more distinct worms under one name. I append a list of his species, so far as it is possible to identify them, and then give some details as to the individuals:—

(1) *Acanthodrilus uliginosus*, Hutton.

Syn. *Lumbricus uliginosus*, Hutton.

(2) *Neodrilus monocystis*, Beddard.

Syn. *Lumbricus campestris*, Hutton, partim.

(3) *Lumbricus rubellus*, Hoffmeister.

Syn. *Lumbricus campestris*, Hutton, partim.

(4) *Allolobophora caliginosa*, Savigny.

Syn. *Lumbricus levis*, Hutton, partim.

(5) *Octochætus* (?) *levis*, Hutton.

Syn. *Lumbricus levis*, Hutton, partim.

(6) *Allolobophora fætida*, Savigny.

Syn. *Lumbricus annulatus*, Hutton.

(7) *Plagiochæta sylvestris*, Hutton.

Syn. *Megascolex sylvestris*, Hutton.

(8) *Plagiochæta lineata*, Hutton.

Syn. *Megascolex lineatus*, Hutton.

(1) Of the six "types" I have been able to examine in detail only five; but I cannot discover the original of "*Lumb.*"

* 'New Zealand Journal of Science,' i. 1883, p. 535, note.

uliginosus." Nevertheless it is evident that it is an *Acanthodrilus*, but impossible to say whether it belongs to any species more recently and more carefully described; it seems best in such a case to leave the matter alone, and to regard it as a distinct species.

(2) "*L. campestris*."—There are three bottles so labelled, which I will indicate by the letters *a*, *b*, *c*.

(a) Contains two individuals collected in Dunedin; they are well-preserved mature worms, which are at once recognizable as belonging to that curious Acanthodrilid which Beddard * termed *Neodrilus*, a genus which he now refuses to recognize as distinct from *Acanthodrilus* †. It seems to me that the characters of *N. monocystis* are every bit as distinctive and important as those upon which he founds the genus *Octochætus*. At any rate, Hutton's worm is characterized by the single spermiducal gland, the single spermatheca, and other features, a detailed account of which was published by me in 1892 ‡. The worm is common around Dunedin, and, as a matter of fact, the very first earthworm I picked up in the bush round the town was *N. monocystis*, from which Hutton's type does not differ.

As will be seen below, it is impossible to retain Hutton's specific name, since he has confused under it two distinct worms.

(b) Labelled "Water of Leith," contained a single individual and a portion of a worm, which are also *Neodrilus*.

(c) Labelled "Wellington," contains three individuals, all of which agree one with another in external characters, viz. the prostomium reaches to the first intersegmental groove, and is traversed by an indistinct transverse furrow; the clitellum covers the segments 27 to 32, while the twenty-sixth exhibits some glandular modifications; the tubercula pubertates are on the segments 28 to 31; the first dorsal pore is between the segments 6/7. With the exception of the last feature, and in the fact that the worms are slightly smaller than usual (viz. $1\frac{1}{2}$ to 2 inches), these specimens agree with the descriptions of *Lumbricus rubellus*.

A reference to Hutton's description shows that he had both *Neodrilus* and *Lumbricus* before him, as he says "Colour

* Beddard, "Observations on the Structural Characters of certain new or little-known Earthworms," Proc. Roy. Soc. Edinb. 1887, vol. xiv. p. 157.

† 'Monograph of the Order Oligochæta,' 1895.

‡ Benham, "Notes on Two Acanthodriloid Earthworms from New Zealand," Quart. Journ. Micr. Sci. vol. xxiii. p. 289.

reddish [as it is in the latter] or olivaceous green" [as in the former worm]. The position of the clitellum is said to be "irregular, commencing on any segment from 10 to 20," which is inaccurate whichever worm he referred to, though it is not so far out if *Neodrilus* was before him. Further, "the male genital pores [by which he means the spermathecal pores] are on the ninth segment" is true for *Neodrilus**, for in this worm these pores are fairly conspicuous, which is not the case in *Lumbricus*. The statement "vulvæ [*i. e.* the male pores and papillæ] on the two last segments of the clitellum" evidently refers to *Neodrilus*. His accounts of the chætæ and prostomium apply equally to either worm.

His statement that "the olivaceous specimens occur in the bush" is perfectly correct, whereas the red (*L. rubellus*) is common in the gardens round the towns.

(3) "*Lumbricus levis*."—Of this there were two bottles:—

(a) "Hampden," contains one individual measuring $1\frac{1}{2}$ inch in length, with spaced nearly equidistant chætæ on each side:—If a be the most ventral chæta, $a-b=c-d$; while $b-c$ is slightly greater than $a-b$; and $a-a=d-d=2a-b$.

The clitellum covers segments 14 to 19. The worm is not fully mature, and I am unable to recognize the male pores. Internally—for I dared to open the type—I note that the dorsal vessel is double throughout, as in some species of *Octochætus*; there is a large gizzard in the sixth segment, and two pairs of spermathecæ in segments 8 and 9, each with a single small rounded diverticulum lying in the same segment.

These are all the facts that I was able to be sure about, but they are sufficient to refer the worm with the greatest probability to the genus *Octochætus*. It is smaller than any of Beddard's species.

(b) Labelled "Dunedin," contains also a single specimen measuring 4 inches, and is *Allolobophora caliginosa*, one of the commonest introduced species about the town.

Hutton's account of "*Lumbricus levis*" seems to have had reference to this individual, for he gives the length as "3 to 4 inches; pale flesh-colour. . . . Setæ feeble, in four rows behind the clitellum, absent before the clitellum." This last statement I cannot understand; moreover he represents them, correctly, on the anterior segments; yet he points out that in this particular the worm differs from *L. communis*, another name for *L. caliginosa*.

* In the method of enumeration now adopted we must subtract one from Hutton's numbers.

But his account of the clitellum as "commencing between the fifteenth and twenty-fifth segment" is evidently due to a comparison between the two worms, as are also the following sentences:—"Male genital openings on the tenth to the fifteenth segments" (*i. e.* spermathecae). "Vulvæ on the two last segments of the clitellum" may refer either to the male papillæ of *Octochætus* or to the tubercula of *Allolobophora*.

(4) "*Lumbricus annulatus*."—A bottle labelled thus contains four worms collected in Dunedin. Only one is mature and possesses a clitellum, but the three others, which are but imperfectly preserved, agree in regard to size and position of the dorsal pore. The worms are, indeed, nothing other than *Allolobophora fætida*, as Hutton himself suspected. I must correct his statement that the clitellum is "not tuberculated inferiorly," for the tubercles exist as a curved indistinct ridge on the segments usual in the species, viz. 28, 29, 30, and extend on to 31.

(5) "*Megascolex sylvestris*."—A single bottle of worms collected in Dunedin, in rotten wood in the bush, contains two entire individuals and two portions; all are very poorly preserved, but in sufficiently good condition to show that, as Beddard has surmised ('Monograph,' p. 522), the worm belongs to my genus *Plagiochæta*.

It differs from *P. punctata* in the following points—and possibly in others—though, of course, I was unable to make a thorough examination of the specimens:—(1) It is cylindrical, not depressed; this may be due to its soft condition. (2) The dorsal and ventral gaps in the chætal rings are equal, and measure twice the normal gap between the individual couples; whereas in *P. punctata* the dorsal gap is about four times the normal. (3) The prostomium, as Hutton figures, does not cut right through the first segment. (4) There are apparently only three pairs of sperm-sacs, that in the ninth segment not being visible. (5) The chætæ measure 0.19 millim., the ventralmost couple, in my sections, reaching 0.22 millim., while the smallest is 0.165 millim. (in *P. punctata* they measure 0.36 millim.).

(6) "*Megascolex lineatus*."—Collected under dead leaves at Queenstown. The bottle contains one entire individual and three broken ones; all are so poorly preserved that they scarcely withstood handling. The length of the entire specimen is only $1\frac{1}{2}$ inch. Hutton's drawing of the pro-

stomium is incorrect in representing it as much too narrow ; it is more like that of the preceding species, but cuts through the first segment. The chætæ are *not* in a continuous circle, but are quite evidently arranged in couples as in *Plagiochæta*. The specimen must have been more deeply pigmented than *P. sylvestris*, for whilst that is now absolutely colourless, this is faint brown.

The following points seem to differentiate it from *P. punctata* :—(1) The dorsal gap is three times and the ventral gap twice the length of a normal gap. (2) The spermiducal glands open on distinct papillæ, and there is no such marked ridge round the ventral "area" in this region as occurs in *P. punctata* (this may possibly be due to imperfect preservation). (3) The spermatheca has *two* peculiar diverticula in place of a single cylindrical one ; of these, one is an oval pouch, the other is a three-lobed pouch with a narrow neck ; they both open close together into the duct of the main sac. (4) The chætæ measure 0·22 millim., and are stouter and more strongly curved internally than in *P. sylvestris*.

Both these species agree with *P. punctata* in having 13 couples of chætæ on each side, which are inserted between distinct and separated bundles of longitudinal muscles, of which there are 12 on each side ; these are visible in transverse sections even between the chætal rings. The most dorsal and most ventral couples of chætæ are separated from their fellows respectively by a broader bundle, which appears to vary in size in the three species.

The nephridiopores alternate in position from segment to segment more or less regularly, and, as in *P. punctata*, the ventral pore lies between the third and fourth bundle, the dorsal pore between the ninth and tenth bundle, counting from below, as I have figured in pl. xv. fig. 17 (*loc. cit.*).

Dunedin,
Aug. 11, 1898.

XVIII.—*Notes on the Family Hetrodidæ, with a List of the described Species.* By W. F. KIRBY, F.L.S., F.E.S., &c.

[Concluded from p. 102.]

Notes on various Genera and Species of the Family Hetrodidæ.

Genus HETRODES, Fisch.

Walker has described four species, allied to *H. pupus*, Linn., viz. *H. marginatus*, *productus*, *macrurus*, and *abbreviatus*.

How far they are truly distinct cannot well be decided without a long series of *H. pupus* from various localities, showing its extent of variation. *H. marginatus* is a male in which the pronotum is greatly elevated and slightly indented on the hind border, and the smooth portion behind and below the hinder lateral spines is much broader than in any other specimen. The other three species (?) are females, and differ considerably in the comparative length of the ovipositor, and *H. abbreviatus* has only three rows of spines on the abdomen. I do not know Fieber's *H. variolosus*, which is too briefly described.

Genus ACANTHOPLUS, Stål.

The type of this genus is *Hetrodes longipes*, Charp. *H. pallidus* and *discoidalis*, Walk., form a second section in the genus, characterized by having all the femora unarmed both above and below. *H. pallidus* differs from the other two species in having the third joint of the antennæ much longer than the second, and from *A. longipes* in having the disk of the pronotum between the spines much more coarsely punctured than the back and sides. *A. discoidalis* is from Caffraria.

Acanthopius desertorum, sp. n.

Long. corp. 29 millim.; pron. 10; fem. post. 18; tib. post. 21.

Male.—Brownish yellow, paler on the face and under surface of the legs.

Eyes prominent, reddish. Antennæ reddish, except at the base; vertex with shallow, irregular, subconfluent punctures, inter-antennal tubercle almost obsolete; a transverse depression, slightly edged with black at the sides, above the clypeus; mandibles tipped with black; pronotum thickly and closely punctured, much more coarsely in front than on the raised portion, bordered by a yellow carina, which is indented in the middle in front, and armed with 3 long spines on each side, converging behind, and behind these is a deep sulcus before the raised part of the pronotum. On the sides the sulcus divides, passing before and behind the first of two more long lateral spines on each side, the second of which is placed above the first in front of the raised hind part of the pronotum, on the back of which are two more central spines, rather near together. Abdomen with the segments dotted with yellow towards the sutures; the sides yellowish, above which is an obsolete dusky band

on each side. On the median line is a short sharp spine pointing backwards at the extremity of each of the first five segments; on the sixth this is replaced by a carina. Front coxæ strongly spined; all the femora unarmed; all the tibiæ sulcated on the sides and (except the front tibiæ) more strongly above; front tibiæ unarmed above, but with 6 or 8 spines on each side below, the base being unarmed; middle tibiæ with 1 spine on the outer and 3 on the inner carina above, and with 6 on each side below; base unarmed; hind tibiæ with 6 to 10 spines on each side above, those in the outer row ceasing before the tip, and with from 6 to 8 on each side below.

Hab. Kalahari Desert (*Cunningham*).

Allied to *A. discoidalis*, Walk.; but in *discoidalis* the middle tibiæ are armed above with only one or two spines on the outer edge. *A. Speiseri*, Brancs., has two spines on the middle tibiæ above, but differs from both *A. discoidalis* and *A. desertorum* in having no more than three in the outer row in the hind tibiæ.

Acanthoplus serratus, sp. n.

Long. corp. (cum app.) 31 millim.; pron. 10; fem. post. 17; tib. post. 22.

Female.—Dark brown above, inclining to reddish on the pronotum, especially behind; vertex and pronotum rugose-punctate, most strongly on the front of the pronotum; inter-antennal tubercle very short, antennæ reddish beneath; face yellowish, reddish above; spines of pronotum nearly as in the last species; abdomen with the first five segments spined in the middle; under surface smooth, yellowish; anal appendages reddish; valves of the ovipositor strongly serrated above; legs varied with testaceous at the joints; front coxæ spined; femora unarmed; front tibiæ unarmed above and with two rows of about seven spines beneath, not extending to the base; middle tibiæ with 3 to 4 small spines above on the outer carina only, and with 6 on each side below, the basal third unarmed; hind tibiæ with two rows of 5 to 8 spines above and of 6 to 9 below.

Hab. King William's Town (*Spencer*).

A longer and narrower species than the last.

Acanthoplus germanus, sp. n.

Female.—Very similar to the last species in size and general appearance. The pronotum is brown, coarsely rugose-punctate in front, and more finely behind. The

abdomen is bronzed, carinated, with a strong median tooth on the second segment only, but with lateral teeth also on the second and third segments. The valves of the ovipositor are armed with fewer and larger teeth than in the last species. The face is yellow, the mandibles tipped with black, and the legs are mostly testaceous, especially beneath. The femora are unarmed, the front coxæ are spined; the front tibiæ are unarmed above and armed with two rows of 7 or 8 spines below, not extending to the base; the middle tibiæ are armed with 2 spines on the outer carina above and with 7 on each side below; and the hind tibiæ are armed with double rows of about 8 spines each both above and below.

Hab. King William's Town (*Spencer*).

Genus ENYALIOPSIS, Karsch.

This genus includes several closely-allied forms from East Africa and Angola. *E. Petersii*, Schaum, and *E. Durandi*, Luc., may perhaps be distinguished by the shape of the lateral prominence at the front angles of the pronotum, which is long and broadly bifid in *E. Petersii*, but shorter, broad and convex, with a short tooth on each side in *E. Durandi*. But it is doubtful how far this character will remain constant in a large series of specimens. I think *E. Bloyeti*, Lucas, is the same as *E. Petersii*, but am more doubtful about *E. obuncus*, Bol.

Genus ANEPISCEPTUS, Fieb.

The insect which I identify with *Hetrodes Servillei*, Reiche and Fairmaire, is common in Somaliland, and greatly resembles *Eugaster Revoilii*, Lucas, except in its smaller size. *E. Servillei*, Lucas, differs entirely in the arrangement of its spines, and I propose to rename it *Anepisceptus hippolyti*.

Eugaster suakimensis, Kirb., should be referred to *Anepisceptus*.

Genus EUGASTER, Serville.

I cannot identify the species which Dr. Karsch briefly describes as *Eugaster spinulosus* in Berl. ent. Zeitschr. xxxii. p. 463 (1888), especially as no locality is given.

Genus ACANTHOPROCTUS, Karsch.

Hetrodes fortis, Walk., is evidently synonymous with *H. cervinus*, De Haan. Of *H. militaris*, White, I have only two damaged specimens before me, but think it will prove to

be distinct when a longer series of South-African Hetrodidæ is received.

Acanthoproctus Howarthæ, sp. n.

Long. corp., ♂ 22 millim., ♀ 38 millim. (app. anal. 6 millim.).

Female.—Head testaceous; labrum, space round the frontal horn, and antennæ (except the two basal joints) chestnut-brown. Head above the antennæ rugose, below smooth and shining. Antennæ about 53-jointed, the scape enlarged, about as long as broad; second joint enlarged but less so, the rest mostly longer than broad, but differing considerably, and apparently irregularly, in their comparative lengths. Horn stout, pointed, nearly straight, about three times as long as the scape. Pronotum reddish brown above, testaceous on the sides, and with all the lateral spines testaceous; strongly rugose, with two transverse depressions behind the frontal ridge, and another at about three quarters of its length; a reddish longitudinal depressed line behind the frontal ridge, with three broad pyramidal elevations rather than spines, obtusely rounded off at the summit, on each side. Frontal ridge with two large but obtuse teeth in the middle, and with a trifid lateral horn, the outermost point the longest, slightly recurved, the second short, nearly straight, and the innermost long, projecting forwards, about as far from the second as from the central teeth, and as they stand apart. From the front of the central mass of the pronotum projects a large obtuse spine on each side, and on the hinder portion of the pronotum is a series of seven large spines at equal distances, the front pair being the largest, and the rest diminishing. Below the front pair is another tooth of equal length, with a short one at its base; there is also a conspicuous spine on the front coxæ, and a smaller one, with indications of others, on the lower lateral border of the pronotum before the front coxæ. Legs testaceous, moderately long; femora unarmed, with slight transverse ridges; all the tibiæ below with three pairs of small spines towards the extremity (including the terminal spines); hind tibiæ with an additional pair about the middle of their length; pulvilli black. Abdomen black, varied with reddish above towards the base, and with three dorsal rows of strong spines, tipped with red and pointing slightly backwards from the second to the sixth segment; on the seventh the lateral ones are replaced by warts, as is the central one on the eighth segment; on the second segment is an additional small spine, below each of the lateral ones; on segments

2 to 6 there are three small warts between the middle and lateral spines and a single one below each of the lateral spines, and the space around and between the spine and warts and the centre of the under surface of the abdomen is finely and transversely striated. Anal appendages testaceous, tipped with reddish; upper ones upcurved at the extremity, and with a large blunt subserrated pyramidal elevation nearer the base; lower appendages straight, moderately slender, pointed, about as long as the upper ones.

Male.—Similar but smaller; reddish, varied with black; pronotum irregularly banded and marked with black in the middle, behind the lateral projections, and on the sides; on the abdomen there are irregular double black bands in the middle and on each side, and there is one row of conspicuous warts between the central and lateral spines, the others being more slightly indicated in the female. Femora black above, with longitudinal rows of red spots.

Collected by Miss Anna Howarth in E. Karoo, Cape Colony, in September 1896. There is another specimen in Mr. W. L. Distant's collection from near Grahamstown.

In *A. cervinus*, Burm., and *A. militaris*, White, the spines round the hinder part of the pronotum are much smaller, more numerous, and closer together.

Genus HEMIHETRODES, Pictet.

Pictet describes his *H. Peringueyi* as having the abdomen black above, or with three black bands. The latter form will sink as a synonym of *H. vittatus*, Walk., but the name *H. Peringueyi* may be retained for the form with a black abdomen, whether it ultimately proves to be a species or a variety. Pictet's suggestion that *Hetrodes Bachmanni*, Karsch, may be a *Hemihetrodes* is inadmissible, for Karsch cannot have failed to notice whether the tibial cavities were open or rimate; and they are evidently intended to be represented as open in his figure of *H. Bachmanni*.

Genus APHRACTIA, nov.

|| *Enyalis*, Stål, Cefv. Vet.-Akad. Förh. xxxiii. (3) p. 58 (1870).

Eugaster, div. a, Stål, Rec. Orth. ii. p. 22 (1874).

This genus, which has been fully characterized by Stål, may be distinguished at once from *Acanthoproctus* and *Hemihetrodes* by its spineless abdomen. The type is *Hetrodes diadematus*, Stål, of which I have no doubt that *H. crassipes*, Walk., and *Acanthoproctus ibex*, Pict., are synonyms.

XIX.—*Hippolyte fascigera*, Gosse, and *H. gracilis* (Heller).
By ALFRED O. WALKER.

IN September last I received from Mr. F. W. Gamble, who is working at the physiological causes of the variability in colour of *Hippolyte varians*, Leach, a specimen which he rightly considered to be *H. fascigera*, Gosse. The colour of the specimen, when received by me in formaline, was pale green, and, with the exception of the tufts of plumose setæ on the body, does not differ from *H. varians*.

H. fascigera was described by P. H. Gosse in the Ann. & Mag. Nat. Hist. ser. 2, vol. xii. (1853) p. 153. He says the tufts are "very deciduous," and, "when wanting, the animal may easily be mistaken for *H. varians*," &c. Further, he says that "it may be distinguished at once, while alive, by its colour, which, though varying, does not assume any of the phases of *H. varians*. It is usually pellucid white, clouded with opake drab, and generally blotched with dark reddish purple." Again, he states that the relative position of the teeth on the lower margin of the rostrum and "the relation of the filaments of the internal antennæ to each other in length and thickness also afford a good distinction."

In 1882 Prof. G. O. Sars ('Oversigt af Norges Crustaceer,' p. 46 [separate copy]) says that he is still doubtful of the specific distinctness of *H. (Virbius) fascigera* from *H. varians*, but he agrees with Gosse's description of its colour.

Prof. W. A. Herdman, F.R.S., in an article on the protective colouring of *H. varians*, in Trans. Liverpool Biol. Soc. vol. vii. (1893) p. 77, says that "specimens found on a sandy bottom or on small gravel are mottled black, grey, and white."

My own experience agrees with the last writer's, but I am not prepared to say that these forms had not the tufts of plumose setæ, as when I took them my attention had not been directed to *H. fascigera*. In looking through a number of *H. varians* in spirit from rock-pools on this coast, I had no difficulty in finding four or five tufted specimens, but their colour had gone. In other respects there is no difference between them and the ordinary form.

It is well known that *H. varians* is not only variable in colour, but almost, if not quite, as variable in the dentition of the lower edge of the rostrum. Kinahan (Nat. Hist. Review, vol. iv. (1857) p. 518) says "a volume might be written on the forms of the beak of this species"; he figures six varieties

on pl. x. (ix. in error). It is, however, to be noted that all these and all the specimens I have ever seen of *H. varians*, as well as Gosse's species, have only *one* tooth at the base of the rostrum, on the upper margin, and that the lower margin in adults is more or less strongly convex.

Gosse's distinctive characters therefore, besides the fascicles or tufts, consist practically only of the colour, the position of the teeth on the lower margin of the rostrum (both of which are notoriously variable), and the relative thickness of the antennular filaments, which is purely a matter of age and sex.

Mr. Gamble informs me that a fascigerous specimen shed the fascicles during life, so that they do not appear to be an integral part of the integument. And if it can be shown that similar tufts of setæ occur on at least one other species of *Hippolyte*, as I propose to do, their specific value disappears.

In the 'Journal of Marine Zoology,' vol. ii. p. 101, the editor, Mr. Jas. Hornell, has an interesting article on "The Protective Colouring of the *Æsop* Prawns," in which he mentions that *H. varians*, when moved to water containing weeds of a different colour from its original habitat, changes its colour to that of the weeds in a single night. He goes on to say that *H. fascigera* has much less power of colour adaptability, that it "is seldom found in any number except among tufts of coarse *Corallina*, with which it agrees *absolutely* in colour," and that its "tufts of brush-like hairs" harmonize with the minute tubicolous Annelids and Bryozoa of the rock-pools it inhabits, so that "the mimetic adaptation is greatly accentuated." But he adds in a footnote that it differs from *H. varians* in that "the only spines on the upper edge of the rostrum are *three* placed at the posterior end and really upon the carapace, while a single sharp tooth is set close to the tip on the *straight* under edge." Had Mr. Hornell seen Gosse's description of *H. fascigera* he would have recognized that the rostrum there described differed entirely from his. At my request Mr. Hornell kindly sent me a specimen which is certainly well furnished with the tufts of setæ, and as certainly is not *H. fascigera*, Gosse; it is, in fact, *H. gracilis* (Heller), a species not hitherto, so far as I know, recorded west of the Mediterranean.

According to Czerniavsky ('Crustacea Decapoda Pontica littoralia,' 1884, p. 15, pl. i.) the rostrum of this species is very variable. He figures ten or eleven forms in which the number of teeth on the upper edge at the base of the rostrum ranges from two to five, and those on the almost or quite straight (sometimes slightly concave) lower edge from one to

four. Mr. Hornell's specimen agrees with Czerniavsky's figure M.

In an earlier work by the same author ('Materialia ad Zoogr. Pont. comp.' 1868) he figures still more varieties, for drawings for which I am indebted to Dr. A. M. Norman, F.R.S., who called my attention to the fact that in two of them are shown tufts of plumose setæ.

Fig. 1.



Fig 2



Fig. 1.—*Hippolyte varians*, Leach. (After Kinahan, Nat. Hist. Review, vol iv. 1857, pl. x.)

Fig. 2.—*Hippolyte gracilis* (Heller). (After Czerniavsky, Crust. Decap. Pontica littoralis, pl. i.)

As it appears therefore (1) that the fascicles or tufts of setæ are not confined to *H. fascigera*, and (2) that the other distinctive characters relied on by Gosse are of no value, we may safely conclude that this species should be expunged from our lists.

There remains the interesting question as to the mode by which the tufts are acquired for protective purposes. It is to

be hoped that Mr. Gamble's researches may throw some light upon this point.

Nant y Glyn, Colwyn Bay,
Nov. 28, 1898.

The Owens College, Manchester,
Nov. 29, 1898.

DEAR MR. WALKER,—

I have read the MS. which you have kindly permitted me to see. At Piel the regular habitat of *fascigera* is among masses of the polyzoon *Bowerbankia* growing on the stems of *Halidrys siliquosa*. Adults taken from this habitat agree in colour fairly closely with Gosse's description, but in captivity among green weed change in colour to a greenish or greenish-brown tinge. Should they then, as they do sometimes, shed their fascicles, there remains no feature by which they can be distinguished from typical *varians*.

The young *fascigera* may inhabit the same *Bowerbankia*, and are then freckled with brown and reddish spots on a transparent ground. But, in addition to this variety, specimens taken from fine plumose red weeds are lined and barred with red. Others, again, have a densely pigmented sheath of brown or black colour to the alimentary canal and two broad transverse bars of the same colour. Both this and the red-lined variety are also found in specimens of *H. varians* (that is, in specimens with no trace of plumose hairs) in the same haul.

It would therefore appear that the colour of the young is not distinctive.

As to the plumose hairs themselves, they are apparently normal structures, though not always symmetrically placed in the segments in which they occur; and if Gosse was right, as I believe he was, in considering them deciduous structures, I think we ought to have more evidence before considering them to be aids in protective mimicry.

I ought to add that the subject did not occupy my attention when working at Piel as fully as it does now, and therefore the observations I made should be considered as preliminary to a fuller treatment of the subject.

I am,

Yours truly,

F. W. GAMBLE.

XX.—On *Siriella armata* (M.-Edw.) and the reputed Occurrence of *S. frontalis* (M.-Edw.) in British Seas. By E. W. L. HOLT and W. I. BEAUMONT.

Siriella armata (M.-Edw.).

Siriella (*Cynthilia*) *frontalis*, Norman, Ann. & Mag. Nat. Hist. 1892, x. pp. 152, 153; W. Garstang, Journ. Mar. Biol. Assoc. iii. p. 221.
Mysis producta, Gosse, Ann. & Mag. Nat. Hist. ser. 2, vol. xii. p. 156.

In examining a considerable collection of *Siriella* taken at various parts of the coast from Start Bay to Falmouth, we have been unable to find a single male that can be referred to *S. frontalis*, although that species has been recorded from Plymouth by Norman and by Garstang, in each case from a single specimen. *S. frontalis* (*Pseudosiriella frontalis*, Claus, Arbeit. Zool. Inst. Wien, v. iii. p. 6) differs from all its congeners in having the male organ of the pleopods simple and leaf-like, instead of bilobate and convoluted. In other characters *S. frontalis* and *S. armata* are extremely alike, so that there is difficulty in distinguishing females when no males are available, as was at first our case, from existing descriptions. In nearly all our gatherings, however, both sexes are present. All males have the appendages of the pleopods bilobate and convoluted, but in males and females alike the characters of the telson show considerable variation and appear to us to be of doubtful value in diagnosis. The number of terminal spinules between the large postero-lateral pair of spines of the telson ranges from three to five, while the spinules in the intervals between the spines on the lateral borders of the same organ approach in many cases the formula of *S. frontalis* (Norman, *loc. cit.*) rather than that of *S. armata* (Norman, 4th Ann. Report Fishery Board for Scotl. p. 163). Sars has given figures* of the antennal scales in the two species, showing a fairly obvious difference in shape; in our specimens that appendage, while agreeing best with *S. armata*, shows an undoubted approach to the condition of *S. frontalis* in some cases. The pereopods are described as more slender in *S. armata* than in *S. frontalis*. Such a character is difficult to seize without comparison of undoubted examples of the two species; but all our specimens appear referable in this particular to the first-named.

We were thus irresistibly compelled to the belief that of

* G. O. Sars, 'Middelhavets Mysider,' pl. xxxiv. fig. 2 & pl. xxxv. fig. 4.

the two species only *S. armata* was represented in our collection, but judged it prudent to appeal for assistance to the great experience of Dr. Norman, who requests us to state that his Plymouth specimen, which by some unaccountable error was recorded as *S. frontalis*, proves on re-examination to be a female of *S. armata*. We have examined Mr. Garstang's specimen: it is a female of *S. armata*, showing characters which are fully covered by the range of variation in the examples of this species in our own collection. We further learn from Dr. Norman that a tube of *Siriella* received by him from this Laboratory as *S. frontalis* contains only *S. armata*. *S. frontalis* must therefore be erased for the present from the British list, since Dr. Norman now thinks that Gosse's *Mysis producta* is in all probability *S. armata*.

We are requested by Dr. Norman to state that his description of *S. frontalis* was drawn up from that of Sars compared with Adriatic specimens received from Dr. Claus. Its validity is therefore in no way impaired by the accidental insertion of an erroneous record of locality.

Laboratory of the
Marine Biological Association,
Plymouth.

XXI.—On new small Mammals from South America.

By OLDFIELD THOMAS.

Oryzomys bæops, sp. n.

Very similar externally to *O. laniger* and *O. niveipes*, but really allied only to the latter. Fur long, soft and woolly. General colour dull greyish brown, darker along the middle line of the back. Under surface silvery greyish, the hairs dull slate for their basal two thirds; no trace of the buffy or fulvous tone found in the other two species. Back of ears scarcely darker than general colour. Hands whitish above; feet pale brown. Tail rather longer than head and body, closely scaly, nearly naked, greyish brown, rather paler below.

Skull of the general type of that of *O. niveipes*, but with its anterior portion, from the front of the brain-case forwards, markedly shortened and more delicate; fronto-nasal profile quite flat, not convex; nasals short and narrow; interorbital region narrow, concave mesially, its edges faintly marked, neither rounded nor beaded; anterior zygoma-root narrow,

without projecting plate, very much as in *O. dryas*. Palatal foramina narrow, equally contracted posteriorly and anteriorly.

Dimensions of the type (an adult female, measured in skin):—

Head and body 118 millim.; tail 148; hind foot s. u. (wet) 23; ear (wet) 16.

Skull: back of interparietal to tip of nasals 27; greatest breadth 14.6; nasals 8.8×3 ; interorbital breadth 3.5; palatal foramina 5.1×1.9 ; upper molar series 4.7.

Hab. Pita R., above the Chillo Valley, Ecuador. Alt. 3500 metres.

Type B.M. no. 98. 8. 1. 7. Collected May 5, 1938, and presented by Consul L. Sölerström.

This species is readily distinguished from *O. niveipes*, its only near ally, as also from the externally similar *O. laniger*, by its abnormally diminished muzzle, which gives its skull a quite different appearance to that of any known species.

Loncheres punctatus, sp. n.

Size medium. Fur spinous, the spines on the middle of the back about 19 millim. long and 1.3 millim. broad. General colour pale ferruginous, punctulated with white, the head and limbs greyer. The rufous of the back is due to the hairs, which are reddish terminally, with greyer bases. Spines of back greyish white basally, their tips either all black or black broadly tipped with white, the white-tipped spines being most numerous posteriorly, and prominently contrasting with the general colour. Head, both above and laterally, coarsely mixed black and white. Ears with a few fine blackish hairs on their edges and a small tuft of whitish hairs on the antitragus; an indistinct patch behind their posterior bases white. Sides coarsely mixed whitish grey. Under surface throughout white, with a slight tinge of buffy, the line of demarcation well marked. Inner side of limbs white, outer grizzled grey; metacarpals grey; metatarsals grey externally, white internally; digits whitish. Tail of medium length, rather thinly haired, the scales showing through; uniformly brown, scarcely or not lighter below.

Skull with the nasals just about equalling the premaxillary processes behind; frontal region flattened, the supraorbital ridges very broadly expanded; pterygoid processes narrow, not spatulate.

Dimensions of the type (an adult male, measured by the collector in the flesh):—

Head and body 236 millim.; tail 233; hind foot s. u. 34; ear 20.

Skull: basilar length 46·3; occipito-nasal length 58·5; greatest breadth 28·5; nasals $17 \times 6\cdot5$; interorbital breadth 15; palate length from henselion 25; palatal foramina $6 \times 1\cdot8$; length of upper molar series (crowns) 12·8.

Hab. Caicara, Orinoco.

Type B.M. no. 98. 12. 1. 18. Original number 11039. Collected July 2, 1898, by Geo. K. & Stella M. Cherrie. Three specimens obtained, two adult and one young.

This fine species may be readily distinguished from others by the prominent white punctulation of the posterior back, due to the broad white tips to the spines in that region. It may prove to be most nearly allied to *L. semivillosus*, Geoff., from Colombia, which has, however, the back "tiqué de jaune" and other differences.

A bad skin, which has been in the Museum since 1852, I also refer provisionally to *L. punctatus*. It was said to have come from Caracas.

Peromys brevicaudatus orinoci, subsp. n.

Much paler than in the typical form, coloured more nearly as in *P. dimidiatus*. Fur short and velvety, about 5 millim. long on the back. Upper surface from nose to rump pale grey, near "olive-grey" or "smoke-grey" of Ridgway. Sides of head and body ferruginous, this colour extending from the bases of the whiskers along the sides of the head and neck to flanks, and down to the wrists and ankles; at the anterior base of the ear it extends further dorsally than elsewhere, so as to form a ferruginous patch on the head at the back of the ear. Under surface pale buffy, not sharply defined, the hairs dark slaty at their bases. Upper surface of hands and feet blackish brown. Tail furry and dull rufous for its basal half-inch above, the rest thinly haired, blackish.

Skull apparently not distinguishable from that of *P. b. typicus*.

Dimensions of the type (a slightly immature male, measured in the flesh by collector):—

Head and body 111 millim.*; tail 75*; hind foot s. u. 18; ear 17.

Skull: basal length 29; greatest breadth 17; nasals $14\cdot5 \times 5$; combined length of *ms.*¹⁻³ 5·8.

Hab. Caicara, Orinoco.

Type B.M. no. 98. 12. 1. 22. Collected Aug. 10, 1898, by Geo. K. & Stella M. Cherrie. Original number 11100.

* Judging by the skin, I should have considered the body rather longer and the tail rather shorter than the above; but I think it best to accept Mr. Cherrie's measurements as they stand.

This is so evidently a local form of the Guianan Red-sided Opossum that, much as it differs in colour, it seems best for the present to regard it merely as a subspecies of that animal.

Peramys rubidus, sp. n.

Size, proportions, and cranial characters about as in *P. brevicaudatus*, though the muzzle is slightly more slender. Colour uniformly chestnut-rufous all over above and on the sides, the head rather brighter rufous, and the posterior back rather darker. Belly dull buffy grey, the hairs greyish brown basally, dull buffy terminally. Outer side of limbs and upper surface of hands and feet dull rufous. Tail also rufous throughout.

Dimensions of the type (an adult male, measured in skin):—

Head and body (evidently stretched) 160 millim.; tail 64; hind foot s. u. (wet) 18; ear (wet) 13.

Skull: greatest breadth 19.4; nasals 18×5.7 ; interorbital breadth 6.6; palate, length from gnathion 20, breadth 11.6; combined length of *ms.*¹⁻³ 5.9. Lower jaw: back of condyle to tip of first incisor 28.

Hab. Bahia.

Type B.M. no. 55. 11. 26. 9.

This species is founded on the skin from Bahia referred to *P. brevicaudatus* in the 'Catalogue of Marsupials,' colour-characters being at that date thought of less importance than they have since proved to be.

XXII.—*Descriptions of some new Species of Napeogenes.*

By F. D. GODMAN, F.R.S.

Napeogenes aster, sp. n.

N. stellæ, Hew., similis, sed alis anticis costa ad basin nigra, alis ambabus obscurioribus et punctis submarginalibus minutioribus.

Hab. Ecuador (*O. T. Baron*).

I have three specimens of this insect, which is very closely allied to *N. stellæ*, as stated above. It differs in having the outer half of both wings darker, which clearly distinguishes it.

Napeogenes decora, sp. n.

Alis diaphanis, anticis striga basali ferruginea, fasciis duabus (una mediana, altera ad cellulæ finem), venis ad apicem, et marginibus omnibus nigris; alis utrisque albo marginatis.

Hab. Ecuador (*O. T. Baron*).

Very similar to *N. aster* just described, but may at once be distinguished by the much broader black margins of the wings, in having a black stripe crossing the centre of the cell instead of a spot, and in the ferruginous basal stripe of the fore wing being darker. I have only a single male example.

Napeogenes glabra, sp. n.

N. stellæ similis, sed major, et alis magis diaphanis, punctis submarginalibus pallide flavis; anticis margine interno nigro, posticis fascia infra cellulam fere obsoleta, nigra.

Hab. Colombia, S. Martin, Llanos of the Rio Meta (*G. D. Child*).

This is a considerably larger insect than *N. stella*, though belonging to the same group. I have two males and a female; all the markings of the two former are much less distinct than those of the latter.

Napeogenes glycera, sp. n.

Ceratinia antea, Hew., quoad colores fere omnino similis, marginibus externis nigris angustioribus; quoad neurationem alarum certe differt: subtus, sicut in *C. antea*, alis posticis ad basin costæ flavis.

Hab. Ecuador, Sta. Inez (*A. Simson*).

A female specimen long in my collection has the coloration of *Ceratinia antea*, but the neuration of *N. harbora* and *N. apulia*, which I place in *Napeogenes*. It formed part of Mr. Simson's collection which was made in Eastern Ecuador.

Napeogenes elva, sp. n.

Alis diaphanis, venis et marginibus sordide nigris: subtus ferrugineis; anticis ad apicem, posticis submarginalibus, punctis albis.

Hab. Colombia, Bogota.

I possess only a single male example of this species; it does not appear to be very closely allied to any other member of the genus.

Napeogenes glycon, sp. n.

N. cyrianassæ similis, sed alis anticis longioribus, macula triangulari nigra ad medium cellulæ distinguenda.

Hab. British Guiana (*H. Whitely*), Surinam (*C. W. Ellacombe*).

Of this species I have two males obtained by Henry Whitely in the interior of British Guiana and a female caught in February 1892 at Paramaribo in Surinam by C. W. Ellacombe.

The general likeness of the insect to *N. cyrianassa* is obvious, but in the lengthened primaries it resembles *N. adelphe*, Bates. None of the other species of this group of *Napeogenes* have a black spot in the cell of the primaries, which thus becomes a diagnostic character.

Napeogenes otaxes, sp. n.

Alis fulvis; anticis macula ovali in cellulæ medio et parte distali nigris, fascia mediana obliqua et punctis duobus subapicalibus sordide albidis; posticis macula cellulari quatuor ultra eam in linea longitudinali et margine externo angustissime nigris; antennis plerumque flavis, ad basin nigris; capite albo punctato; prothorace et tegulis fulvis; abdomine infra sordide albidio.

Hab. Peru, Chanchamayo (*H. Whitely*).

Allied to *N. pyrrho*, Druce (P. Z. S. 1876, p. 209, pl. xvii. fig. 1), but differs in the absence of the yellow subapical band of the primaries and in the presence of a pale transverse band between the black apex and the fulvous base of the wings.

Of this species I have a single female specimen in rather poor condition.

Napeogenes hygia, sp. n.

Alis anticis ad basin fulvis, fascia integra extrorsum valde sinuata ultra cellulam a costa fere ad marginem externum extensa flava, apice toto marginibus omnibus nigris, macula longitudinali in cellulæ medio maculis duabus ad finem ejus et quarta infra eam nigris, macula altera supra ramum medianum secundum margine externo conjuncta quoque nigra; posticis fulvis, margine externo et fascia elongata mediana infra cellulam nigris: subtus ut supra, alis punctis submarginalibus albis notatis, posticis ad basin costæ flavis: antennis nigris, ad apicem fulvis; capite albo punctato; tegulis et prothorace fulvis; palpis albis, extrorsum et apicibus nigris; abdomine infra sordide flavido.

Hab. Surinam, Paramaribo, Feb. 1892 (*C. W. Ellacombe*).

A distinct species, of which I have one male specimen obtained in Surinam by Mr. C. W. Ellacombe. It has the coloration and facies of *Mechanitis polymnia*, of which it is no doubt a homœochromatic associate.

Napeogenes eunomia, sp. n.

Alis diaphanis, venis et marginibus nigris, punctis submarginalibus albis; posticis marginem internum versus pallide sulphureo tinctis: subtus ut supra, sed punctis submarginalibus albis.

Hab. N. Peru (*Krause*).

I have a single male specimen from Bates's collection which has for a long time remained unnamed. In general coloration it resembles *Ceratinia frater*, but the black margins are narrower and the venation is quite different.

Napeogenes amara, sp. n.

Napeogenes tolosa, G. & S. Biol. Centr.-Am., Rhop. i. p. 27, tab. iii. fig. 4 (partim).

N. tolosæ similis, sed colore nigro apicali basin versus magis extenso maculisque apicalibus flavis minoribus.

Hab. Nicaragua, Costa Rica, Chiriqui.

Since writing on *N. tolosa* in the 'Biologia' a large series of this insect has been received from Guatemala and Chiriqui. The authors pointed out that specimens from southern localities were darker than those from Mexico and Guatemala, but with the material then available they hesitated to separate them. The large series I now have leads me to think the differences are sufficiently great to warrant me in describing the Nicaraguan and southern form as distinct, and I have therefore named it *N. amara*.

XXIII.—On the probable Mode of Formation of the Fusion between the Femur and Trochanter in Arthropods. By EDMOND BORDAGE*.

IN the present communication it is my intention to show what in my opinion are the causes which must have brought about the fusion of the trochanter and the femur in the Phasmidæ. The explanation that I am about to give may, I

* Translated by E. E. Austen from the 'Comptes Rendus Hebdomadaires des Séances de la Société de Biologie,' t. v. no. 28, 5 août, 1898, pp. 839-842: from a separate impression communicated by the Author.

think, be applied to all those Arthropods which exhibit this fusion of the second and third joints of the thoracic limbs, accompanied by the persistence of a groove constituting a *locus minoris resistentiæ*, admirably adapted for ensuring the process of autotomy.

While following attentively the phenomenon of ecdysis, I have been struck by the violent efforts that Phasmids have to make in order to free themselves from their old chitinous envelope. These clumsy Orthoptera, embarrassed by their long legs, do not always succeed in doing so—a failure which is evidently the cause of their subsequent death. At other times they are obliged to make a sacrifice of one or several of their limbs; the latter, always becoming detached at the groove which corresponds to the line of fusion of the femur and trochanter *, remain fixed in the old envelope with which they are shed.

I have been able to observe that out of 100 specimens of *Rhaphiderus scabrosus* which were kept in captivity and protected from all enemies, 9 had perished through being unable to disengage themselves from their old envelope, and that 22 had survived after having sacrificed one or several of their legs (the 69 others accomplished all their ecdyses without mutilations). We see, then, that 31 per cent. of the Phasmids perished or were mutilated through the ecdyses, a figure which I think must sometimes be exceeded. We may judge, therefore, of what must have happened when the disposition which ensures autotomy was non-existent or had not yet acquired the perfection which it exhibits at the present day.

The efforts which the insect is obliged to make in order to disengage itself may in certain cases last for an entire day, and are repeated eight times at least during its existence †. The violent strains which result therefrom affect especially the region of the trochanter and the upper extremity of the femur. I am led to believe that we must regard this mechanical action as one of the principal causes of the fusion of the trochanter and the femur. It is certain that this fusion has not always existed, and that there have been among the ancestral forms belonging to the existing Phasmids insects in which there was a genuine articulation between these two consecutive segments. There has therefore taken place in

* This mutilation is evidently a form of autotomy, which in this case we might term *exuvial* (from *exuviae*, sloughed skin). The regeneration which ensues always produces a tetramerous tarsus.

† Although I have not yet had an opportunity of noting the exact number of the ecdyses, I have nevertheless been able to remark that this number amounts at least to eight.

them later on a veritable phenomenon of ankylosis, bringing about the fusion in question. This is the hypothesis which is adopted by certain authors * in order to explain how, in the case of Vertebrates, articulations may become ankylosed in consequence of severe and repeated tensions and strains †.

The violent strains to which the limbs are subjected at the period of the ecdyses must have had an influence so much the more marked and so much the more efficacious in that at this moment the tissues are in an altogether peculiar condition, and since the integumentary layer which will become the new cuticular covering after the shedding of the old envelope is then still soft. The mechanical action occasioned by the strains has easily produced the thickening, the more intense chitination of the arthrodial membrane, and, in consequence, ankylosis, a condition which, remarkably enough, is precisely the most favourable for securing autotomy in the line of the groove of fusion, which constitutes a *locus minoris resistentiæ*. This condition must have been produced as early as the primary epoch in one of the ancestors with tetramerous tarsus of the existing Phasmids (see my communication of June 28, 1897, to the Académie des Sciences) ‡. The Stegocephali of this epoch were able to contribute to the perfecting of the disposition ensuring the autotomic process.

I would add that modifications in the manner of walking must have been produced at different intervals §—modifications which were themselves occasioned by variations in the general form of the body during the phylogenetic development. They have brought about displacements in the position of the points of support more or less distant from the body, with the object of ensuring the stability of the latter. I think that we must again regard this as a cause of strains and tensions, which have also contributed to the formation of the fusion with which we are dealing. In short, the way in which this special condition has been produced would be explained by the principles of the science which Prof. Giard terms *morpho-*

* See especially Tornier, "Das Entstehen der Gelenkformen," W. Roux's Archiv für Entwicklungsmechanik, 1895.

† In the articulations of Arthropod limbs the arthrodial membrane is compared to a *ligament* by H. Milne-Edwards. In the cases of ankylosis among Vertebrates the ligaments of the joints are precisely the parts which become ossified.

‡ Ann. & Mag. Nat. Hist. ser. 6, vol. xx. (1897) pp. 507-510.

§ These modifications obliging the limbs to be flexed, to be folded further back, or to extend themselves during locomotion, according to circumstances.

dynamics, Prof. Delage *biomechanics*, and W. Roux the *mechanics of development* (*Entwickelungsmechanik*).

The Arthropods in the case of which we observe, either in all the thoracic limbs or in only a single pair, the fusion of two consecutive joints, which ensures autotomy*, appear among those the growth of which takes place by means of ecdyses, during which these animals often have much difficulty in freeing their limbs from the old cuticular envelope, because these members are very long, are terminated by enormous pincers (lobster, crabs), or are provided with large foliaceous adornments (leaf-insects)†. It is probable that in these different cases the mechanical actions produced at the moment of ecdysis must have contributed in a large measure to the development of the peculiar structure in question. I shall shortly publish a detailed study on the Arthropods in which this is found.

In the Phasmids the phenomena of autotomy must have already begun to appear before the complete fusion of the femur and trochanter, the articulation corresponding to these two joints then constituting a *locus minoris resistentiae*. At the outset many of these insects must have perished from the results of hemorrhage. Then, a perfecting process gradually setting in and being transmitted by heredity, the number of the survivors increased. The regenerative faculty must at first have been but slightly marked, and the first regenerations must have been very imperfect. Then, as the fusion between femur and trochanter tended to take place more and more, there was more regularity in the sections corresponding to the amputations, and, in consequence, more regularity in the portion reproduced, until the moment when regeneration was capable of furnishing a limb with a tetramerous tarsus, the joints of which were sharply differentiated one from another.

I therefore believe that this peculiar condition is to be regarded as an example of a character acquired by use, by functional excitation, and then transmitted by heredity, as fast as it advanced towards perfection.

My experiments upon the regenerations following artificial amputations lead me to suppose that an altogether special

* This does not imply that all the Arthropods in which autotomy is found to occur must necessarily exhibit fusion between two consecutive joints of their limbs.

† I have recently been able to remark phenomena of autotomy in leaf-insects which had been sent to me from the Seychelles. In these Orthoptera the fusion between femur and trochanter exists.

mode of selection has played a great part in the perfecting of the regenerated limb. I have been able to remark, in fact, that the regenerated portions were so much the more perfect according as the amputations had been performed with greater regularity and the hemorrhage had been less copious. When the limb is cut off somewhat obliquely, the result is a teratological regeneration with tarsal joints misshapen and but little distinct one from another. A limb so imperfect as this almost always becomes detached from the body at the next ecdysis. The same applies to the limbs mangled by the teeth of the enemies of the Phasmids. Here, then, we have a real selection effected by the ecdyses, and I propose for it the term *exuvial selection*.

XXIV.—Further new Species of Forficularia.

By MALCOLM BURR, F.E.S., F.Z.S.

IN the following paper four new *Forficularia* are described, of which three were taken in Ecuador by Mr. Rosenberg and the other in Java by Herr Frühstorfer. Two of the species from Ecuador will later require a new genus, but the material at hand is barely sufficient for the purpose. These two are considered by M. de Bormans, to whose examination I have submitted all the species described, to be identical; but several small characters, worth little in themselves, but of cumulative value taken together, have induced me to regard them as separate, though closely allied.

I take this opportunity of impressing collectors abroad with the necessity of packing earwigs with extreme special care, as I have at least a dozen novelties in my collection that I am unable to describe, as they are mutilated; for the slightest accident may destroy a valuable character. Of others also I possess only females, which it is highly undesirable to describe without the male.

The number of undescribed earwigs still existing in collections is probably very large; M. de Bormans has informed me that he alone has no less than sixty novelties.

I seize the occasion to express my thanks to this entomologist for the assistance he has very kindly rendered me in examining my types, communicating descriptions of sexes which I do not possess, and for much valuable information.

I have taken the measurements as follows:—of the body, from the mouth to the apex of the anal segment; of the

forceps, from the base to the apex of the longest branch, not including the anal segment, as is often done.

Pygidicrana imperatrix, sp. n.

Statura maxima; caput latitudine pronotum æquiparens, vel eo latius; pronotum ovale, antice rotundatum, postice truncatum, angulis rotundatis; elytra latiora, immaculata; alæ valde prominentes; forceps cruribus validis, depressis, basi subcontiguis, margine externo prope basin dente obtuso armatis, margine interno basi crenulatis, apice decussatis, irregulariter curvatis, crure dextro magis superne, crure sinistro minus inferne curvatis.

Colour. Mouth-parts, frons, abdomen, and forceps black, the rest testaceous.

Head as broad as the pronotum or broader; frons as far as the eyes black; eyes black. *Antennæ* fuscous, ?-segmentate.

Pronotum oval, raised in the centre, the sides and hinder margin flat; all angles rounded, posterior margin straight.

Elytra broad and flat, darkish near the apex, obliquely rounded at the apex. *Wings* protruding well beyond the elytra and paler in colour.

Abdomen black; anal segment large and broad, with a median suture, very faint, the posterior border rounded, emarginate roundly, and not deeply at each side.

Legs hairy, testaceous.

Forceps, ♂, stout; black; the branches are finely crenulate on inner margin at the base; dilated and depressed, straight at first; incurved at the apical third, the right branch being more strongly curved than the left and above it; each branch is armed with a stout conical tooth on the outer margin near the base. ♂.

	♂.
Long. corporis	30 mm.
„ pronoti	5 „
„ elytrorum	8 „
„ forcipis	6.5 „

Patria. Java occidentalis; Mons Gédé at 4000', 1896 (*Frühstorfer*).

This fine species falls into the second group of the genus, characterized by the head being as broad as the pronotum, by the prominent wings, and by the shape of the forceps, which is almost the same in both sexes. The general form of the forceps recalls the shape of that organ in *Psalis* and *Anisotabis*. The type of this group is *P. Dameli*, Dohrn.

Opisthocosmia amazonensis, Borm., sp. n.

"Voisin de *O. americana*, Borm. Antennes (reste 12-art.) forme typique, mais très allongées et grêles (plus que chez *O. americana*), 9 et 10 en partie ou entièrement jaunes-blanchâtres; le reste brun. L'insecte est tout entier brun foncé terne, sauf un petit point jaunâtre à l'angle sutural de l'écaille ailaire, l'extrémité apicale des tibias et le tarse tout entier testacés. La pince est d'un brun rougeâtre, luisant, plus claire que le reste du corps. L'apex de l'abdomen est plus étroit que chez *O. americana*, les pattes plus longues et grêles. ♂.

"Longit. corp. (absque forcipe)	♂.
„ forcipis	10 mm.
„ forcipis	6 „

"Branches de la pince ♂ : allongés, grêles, subdroites légèrement sinueuses, écartés à la base, armées au milieu de l'arête interne d'une dent beaucoup plus longue que large et dont la pointe est obliquement tournée vers le haut (chaque dent touche celle de l'arête opposée). Les branches divergent ensuite très peu, puis se croisent vers le $\frac{5}{6}$ de leur longueur à partir de la base."

Opisthocosmia amazonensis, Borm., in litt.

Type in coll. de Bormans.

I have in my collection a female which M. de Bormans assigns to this species. I add the following description:—

Gracilis, elongata; caput pronoto latius; pronotum parvum, angustum; abdomen apicem versus dilatatum, apice ipso valde attenuatum; pedes gracillimi; forceps ♀ cruribus elongatis, gracilibus, rectis, inermibus, apice decussatis, apicem versus margine interno minutissime crenulatis; caput, pedes, abdomen, et forceps plus minus pilosa. ♀.

Long. corporis	♀.
„ forcipis	14 mm.
„ forcipis	7 „

Patria. Upper Amazons (*de Bormans*); Ecuador, Paramba, at 3500', V. '97, in dry season (*Rosenberg*, in coll. mea). (No. 1321.)

Differs from *O. americana*, Borm., in the longer and more slender antennal segments, by the much narrower apex of the abdomen, by the longer and more slender legs, and, finally, in the shape of the forceps.

Forficula? remota, sp. n.

Corpus glabrum; statura majore; antennæ segmentis 13, gracilibus, elongatis; caput pronoto latius; pronotum angustum, margine antico recto, margine postico subrotundato, angulis rotundatis; elytra basi dilatata, latiora, apice angustata, oblique truncata; alæ valde prominentes; tarsorum articulus secundus cordiformis, minimus; abdomen apice quam basi paullo latius, plicis tuberculi-formibus segmentorum abdominalium 2 et 3 vix distinguendis; forceps ♂ gracilis, cruribus basi dilatatis, subcontiguïs, pygidio tantum separatis, apicem versus attenuatis, incurvis, apice attingentibus, in tertia parte basali supra vel margine interno dentibus validis binis armatis; forceps ♀ gracilis, inermis, cruribus basi contiguïs, subrectis, decussatis; pygidium quadratum, ♂ margine postico minutissime emarginato, ♀ marginibus rectis, integris.

Colour testaceous or reddish, varied with fuscous.

Head large and flat, reddish testaceous or black. *Eyes* black. *Antennæ* long, 13-segmentate, the segments long and slender; segments 10-11 pale, the remainder darker. *Mouth-parts* pale.

Pronotum small, considerably narrower than the head, paler in colour, raised anteriorly, depressed posteriorly, showing a faint median carinula; anterior margin straight, rectangular; posterior margin slightly rounded; the angles rounded.

Elytra large, fuscous or testaceous, broad at the shoulders, narrower at the apex, where they are obliquely truncate. *Wings* protruding well beyond the elytra, narrow, dark fuscous, sometimes with a large pale discoidal spot.

Legs pale testaceous; femora and tibiæ with a few hairs; tarsi hirsute.

Abdomen reddish testaceous, slightly broader at the apex than at the base; the tubercles of the second and third segments very faint.

Forceps testaceous. ♂ with the branches dilated at the base, subcontiguous, only separated by the pygidium; the basal third is dilated, armed in the centre and at the apex of this third with a blunt tooth, sometimes directed horizontally, sometimes perpendicularly, the basal part itself minutely crenulate on the inner margin; from the second tooth the branches attenuate, incurved, to meet at the apex, where they slightly decussate. ♀ with branches attenuating from the slightly dilated base, nearly straight, decussating near the apex, concealing the pygidium.

Pygidium square; ♂ with the margins faintly crenulate,

the posterior margin very faintly emarginate; ♀ with margins smooth and straight. ♂ ♀.

	♂.	♀.
Long. corporis	14.5 mm.	16 mm.
„ pronoti	2 „	2 „
„ elytrorum	4 „	4.5 „
„ forcipis	5.5 „	5.75 „

Patria. Ecuador, Chimbo, 1000', VIII. '97; Cachabé, low, I. '97, XII. '96 (*Rosenberg*). Type in coll. mea.

This earwig and the following will require a new genus when further allied species are discovered. The slender antennal segments, the narrow pronotum, and the broad elytra betray affinity with *Opisthocosmia*, Dohrn, while the general form of the forceps, dilated at the base and slender beyond, with the presence of abdominal tubercles, however faint, show intimate connexion with *Forficula*, L. The second tarsal segment is distinctly cordiform, and not cylindrical, and is very minute, being no broader than the other segments.

Forficula? divergens, sp. n.

A *Forficula? remota* differt:—Statura minore, abdomine cylindrico, colore fusciori. ♂ forcepe cruribus dente singulo subperpendiculari armatis; ♀ cruribus pygidio distincte separatis, basi dilatatis, dehinc attenuatis, fere rectis, apice attingentibus, nec decussatis. ♂ ♀.

	♂.	♀.
Long. corporis	9-10 mm.	8 mm.
„ elytrorum	2.5 „	2.5 „
„ forcipis	2.5-3 „	2 „

Patria. Ecuador; Cachabé, low, XI., XII., '96; III., '97, at 3500', in dry season (*Rosenberg*). Type in coll. mea.

This species differs so little from the last that it is with hesitation that I give it specific rank; but the general appearance, with the considerably smaller size, darker and more reddish colour, and the slightly different form of the forceps, have led me to describe it as more than a mere variety.

Bellagio, East Grinstead,
December 29, 1898.

XXV.—Notes on Central-American Coccidæ, with Descriptions of Three new Species. By T. D. A. COCKERELL.

THE following species of Coccidæ from Central America have recently come under my notice :—

CEROPLASTES, Gray.

Ceroplastes roseatus, Towns. & Ckll.

Colombia: Panama (*Dolby-Tyler*).

From it Mr. Dolby-Tyler bred the parasite *Lecaniobius Cockerelli*, Ashm.

PARLATORIA, Sign. [not Boiss., 1842, Cruciferæ].

Parlatoria proteus, var. *crotonis* (Ckll.), Ckll.

Colombia: Panama, on *Croton* (*Dolby-Tyler*).

AULACASPIS, Ckll.

Aulacaspis Boisduvulii (Sign.), Ckll.

Mexico: El Cuyo del Chico Sapote, Tabasco, June 18, 1897 (*Townsend*; Div. Ent. 7857 pars).

PSEUDOPARLATORIA, Ckll.

Pseudoparlatoria parlatorioides (Comst.), Ckll.

Mexico: Hermosillo, April 20, 1897, a variety with a white scale and circumgenital glands more numerous, median 0 to 1, anterior laterals 18 to 19, post. laterals 14 (*Koebele*, 1719); Frontera, Tabasco, June 25, 1897, on nopal (*Opuntia*), a variety with the scale pale greyish, exuviae light brown, circumgenital glands 12 in anterior lateral group, 9 in posterior lateral.

It may be that this species, as I understand it, includes two or more; but I am not at present prepared to subdivide it.

ASPIDIOTUS, Bouché.

Subg. ASPIDIOTUS, s. str. (*Evaspidiotus*, Leon.).

Aspidiotus hederæ (Vallot), Signoret.

Mexico: Guadalajara, on fruit of sweet lime, Dec. 12, 1897 (*Townsend*); Oaxaca, on leaves of *Pinus*, Aug. 20, 1897 (*Koebele*, 1697, pars).

Subg. DIASPIDIOTUS (Berl. & Leon.), Ckll.

Aspidiotus subsimilis, sp. n.

Mexico: Cuautla, on a leafless tree, infesting the bark, May 31, 1897 (*Koebele*, 1750); Hermosillo, on *Caesalpinia Palmeri* (?), April 24 (*Koebele*, 1713).

♀.—Scale about $1\frac{1}{2}$ millim. diam., circular, flat, thin, pale grey to whitish, or tinged with brown; exuviae covered, inconspicuous, marked by a whitish boss. This scale is very like that of *A. perniciosus*, but there is no distinct dot and ring.

♂.—Scale oval, slightly stained with blackish; exuviae yellowish.

♀.—Brownish yellow; of ordinary shape; no circum-genital glands; only two lobes, these separated by a wide interval, prominent, upright, shaped about as in *A. perniciosus*, sometimes with a notch on the inner side; spines fairly large, two pairs on each side, and a single one (sometimes a pair) a considerable distance along the margin; squames spine-like, but very minute, hardly to be seen; the usual two marginal incisions on each side, the glandular processes of the first long and straight, the outermost very narrow, the inner longer (in fact, very long for a *Diaspidiotus*) and thickened towards the end, so as to be inversely carrot-shaped; anal orifice near the hind end; linear transverse dorsal glands as in *perniciosus* &c.; from the bases of the lobes extend long brownish root-like processes, as in various other species.

The newly-hatched or embryonic larva has the caudal lobes oblique, distinctly twice notched on the outer margin.

Aspidiotus cyanophylli, Signoret.

Mexico: Orizaba, on myrtle, July 15, 1897 (*Koebele*, 1705).

This species might well be the type of a new section.

Section HEMIBERLESIA, Ckll.

Aspidiotus cupressi, sp. n.

Mexico: Toluca, June 24, 1897 (*Koebele*, 1635). Lives on twigs of *Cupressus*.

♀.—Scale small, about 1 millim. diam., rather convex, white; exuviae subcentral to lateral, covered by a white film, the film often rubbed off, leaving the exuviae exposed, shining

yellow, or sometimes quite coppery yellow. Young scales round and very white.

♀.—Shape ordinary; no circumgenital glands, but numerous dorsal tubular glands, much as in *A. Obeckiæ*; only two lobes, these wide apart, upright, large, rounded, the edges obscurely crenulate; anal orifice circular, close to the bases of the lobes; the usual incisions (two on each side), with thickened edges; spines very small; squames large, narrow, but branched, extending a little beyond the lobes; two squames between the lobes, about eleven on each side beyond the lobe, placed close together.

Aspidiotus Cawii, Ckll.

Mexico: Frontera, on fruit of some palm; scales smaller than usual (*Townsend*).

Aspidiotus Greenii, Ckll.

Mexico: El Cuyo del Chico Sapote, Tabasco, June 18, 1897, on leaves of banana (*Townsend*); on a palm, Mexico city, Dec. 6, 1897 (*Townsend*).

CHRYSOMPHALUS, Ashm.

Chrysomphalus rhizophoræ, sp. n.

Mexico: Tabasco, El Rio Polo, June 19, 1897, on leaves of mangrove (*Townsend*).

♀.—Scale about $1\frac{1}{2}$ millim. diam., circular to oval, slightly convex, shining sepia-brown, sometimes pale coffee-colour, sometimes darker, or even purplish brown; exuviae black, but covered by a dirty white film, leaving the first skin only visible.

♀.—Yellowish; shape ordinary; four groups of circumgenital glands, anterior laterals of 7, posterior laterals 5 in a row; three pairs of low broad lobes, more or less inclined to be serrate, closely resembling those of *C. Boureyi*; median lobes separated by a moderate interval, obliquely truncate, with rounded corners; plates very inconspicuous; margin beyond the lobes serrulate, with three or four small prominences, not so large as those of *Boureyi*; beyond this serrulation there is quite a large spine; processes at the bases of the lobes well developed, only two pairs of long ones, those of the first and second interlobular intervals; the usual pair at the inner bases of the median lobes, about half as long as the long processes; the process mesad of the second long one

short and small, not one third of its length; the process at the outer base of the third lobe about as large as those at the inner bases of the median lobes; the usual row of glands just beyond the second long process, but they are small, much as in *C. calurus*; anal orifice a long way from the hind end, but still caudad of the level of the posterior circumgenital glands.

Chrysomphalus albopictus (Ckll.).

Mexico: Cuautla, on twigs of rose, May 31, 1897 (*Koebele*, 1769; Cuautla, on *Myrtus* (*Koebele*,).

Chrysomphalus ogavis (Towns. & Ckll.).

Mexico: on "Tabucha," May 1896 (*Townsend*). Div. Ent. 7217.

Chrysomphalus dictyospermi (Morgan).

Mexico: Oaxaca, on leaves of *Pinus*, Aug. 20, 1897 (*Koebele*, 1697, pars).

Section MELANASPIS, Ckll.

Chrysomphalus nigropunctatus (Ckll.).

Mexico: Amecameca, June 6, 1897, "on wild tree resembling tobacco" (*Koebele*, 1740); Mexico city, on bark of maple, May 22, 1897 (*Koebele*, 1741); on *Baccharis glutinosa* at Mixcoac, June 22, 1897 (*Koebele*, 1743).

Chrysomphalus lilacinus (Ckll.).

Mexico: Nogales, on *Quercus undulata*, April 10, 1897 (*Koebele*, 1629).

XXVI.—Notes on the Tentacles of *Nautilus pompilius*.

By LAWRENCE E. GRIFFIN*.

THE following notes on the structure and homologies of the tentacles of *Nautilus* describe points which have been of great interest to me and which seem important enough to justify publication preliminary to a complete account of the anatomy of the *Nautilus*.

* From the 'Johns Hopkins University Circulars,' November 1898, pp. 11-12.

All the tentacles of the *Nautilus* are built after a single plan, and preserve the essential features of this even when highly modified. Ordinarily the tentacle is considered to be formed by two parts—a fleshy sheath surrounding an extensible cirrus. The cirrus is the essential structure and will be spoken of as *the tentacle*, while the sheath seems to be merely a fold of the skin which has been produced around the cirrus for protective or supportive purposes. Surrounding the head of the *Nautilus* are thirty-eight tentacles, to which Owen gave the name of *digital tentacles*. The sheaths of these are fused to each other, so that a complete *Cephalic Sheath* (Owen), open ventrally only, is formed. These tentacles have been described as having no regular arrangement; but an examination of fifty-one specimens proved that they are arranged upon each side in a constant order. Only six specimens showed a variation from the normal arrangement, and this variation existed in each case upon one side only. Whether the same tentacle always occupies the same position or not cannot be decided till after further dissection of the nerves going to the tentacles.

The digital tentacles present the structural plan uniformly and simply. The surface of the tentacle is marked by a close series of annular grooves, which are deepest upon the inner side of the tentacle. The tentacles are frequently flattened upon the inner side. A large nerve-trunk occupies the centre of the tentacle; around this are the radial bundles of longitudinal muscles. Closer examination of the nerve-cord reveals that it is enlarged by collections of ganglion-cells at regular intervals, each enlargement corresponding in position to a segment of the tentacle included between two of the annular grooves. From the ganglionic enlargements nerves pass to the different portions of the segment, but especially to the inner side. The segmental structure of the nerve-cord persists in cases where all traces of the external annulations have disappeared.

Dr. Willey, in a recent article, described the great adhesive power of the digital tentacles. This power seemed strange until after a closer study of the segments of the tentacles. The groove between the segments is much deeper upon the inner face of the tentacles than elsewhere. The inner face of the segment is flattened. On this side, between the epithelium and the longitudinal muscles, are radial transverse muscles—the only transverse muscles in the tentacles which we can surely identify as such.

Their operation would be somewhat as follows:—when the flat surfaces of the segments of the tentacles are applied to

any body a contraction of the radial muscles within each segment would pull the central portion away from the opposed surface and cause a vacuum to be formed between the segment and the surface. The adhesive power of any one segment must be slight; but there are from sixty to one hundred segments in each tentacle, half of which would probably be in a position to hold; and there are thirty-eight tentacles in the group. Thus the combined adhesive power of all the segments is very great.

It seems to me probable that we see here the beginnings of the suckers of the Dibranchiates. As these Cephalopods became more active and predatory the simple sucker would naturally have been modified to form an organ better adapted to quick and sure seizing of the prey. Yet the principle of action is the same in the Nautilus and the Dibranchiates. It seems probable that the projecting portion of each segment of the tentacle formed a single sucker. Growth would cause these to take alternating positions. Possibly from each segment several suckers were formed by subdivision of the adhesive surface and the development of each portion into a sucker. These may have remained arranged in transverse rows, as in *Sepia* and other forms.

This theory of the formation of the suckers of the Dibranchiates necessitates our regarding the arms of the Dibranchiates as each corresponding to a single tentacle of the Nautilus, and not to groups of tentacles. The structure, arrangement, and relations of the arms support the first view far more than the second. Comparison with the processes of change in other orders weakens the latter theory, while strengthening the theory that a few tentacles gradually increased in size while the remainder were crowded aside and reduced.

The *ocular tentacles* present several differences of structure from the digital tentacles. Their sensitiveness is much greater. The greater depth of the annular grooves on the inner side is immediately noticed. Willey has found that the sides of the groove are ciliated. In some instances I find the cilia extending over the surface between the grooves.

Of internal structure two points are especially remarkable. One is struck by the ease with which the tips of the ocular tentacles break off. This seems to be the result of a peculiar arrangement. In the plane of the annular groove the adjoining segments are separated by what in sections appears as a plain line along which the tissues are evidently weaker than elsewhere. In apparently normal cases there is no separation of the tissues, but the weak line appears sharply

and distinctly. The line does not extend through the epidermis or the nerve-cord. The lines are only found in the upper portions of the tentacles. It is difficult to understand of what use this arrangement can be. The tips of the tentacles break off with exceeding ease; but can this be in any way advantageous to the *Nautilus*?

The other point is regarding the structure of the nerve-trunk. There is here what I have termed an *accessory nerve-trunk*. The usual nerve-trunk is present, having its layer of ganglionic cells around its periphery and its ganglionic enlargements in each segment of the tentacle. On the inner side of this, through nearly the entire length of the tentacle, runs a large nerve-trunk, composed of several bundles of nerve-fibres. The main nerve-trunk and the accessory are closely united, but are easily distinguished by the layer of ganglion-cells which surrounds the main trunk. There are very few, if any, ganglion-cells in the accessory trunk. At the ends of the tentacle the accessory trunk gradually disappears, at the upper end by giving off nerves chiefly to the inner side of the tentacle, at the base of the tentacle by gradual union with the main nerve-trunk.

This accessory trunk has apparently been developed in connexion with the remarkable sensitiveness of the ocular tentacles.

The nerves of the two ocular tentacles of each side are branches of a nerve which comes off from the pedal ganglion near the outer end, which also sends branches to the hood.

The hood consists of the fused and enormously enlarged sheaths of the dorsal digital tentacle of each side. The origin of the nerves of the ocular tentacles in the pedal ganglia, and the fact that they form portions of nerves going to the sheaths of digital tentacles, proves, as Dr. Willey has suggested, that the ocular tentacles cannot be considered as other than somewhat modified (and perhaps displaced) digital tentacles, and that they can in no wise be considered as the homologues of the optic tentacles and rhinophores of *Gastropods*.

There is in the female *Nautilus*, ventral to the buccal mass, a fleshy lobe, which, dividing into two near its tip, bears upon each half ten to fourteen tentacles, and at the point of division a rounded organ composed of a number of triangular lamellæ. This lobe (the inferior labial of Owen) is wanting in the male *Nautilus*; instead is found, nearly hidden beneath the buccal mass, a rounded organ, which is named, from its discoverer, *Van der Hoeven's organ*. I think that anatomical evidence is strong enough to convince us that the inferior

labial lobe and Van der Hoeven's organ are homologous

There are about sixteen lamellæ in the group in the centre of the inferior labial lobe. The group is separated at the median line into two halves, the lamellæ of each side facing each other. The largest lamellæ are at the centre of the group, the smallest at the exterior. The lamellæ are marked upon both surfaces by grooves parallel to their bases. A nerve showing some traces of ganglionic enlargements runs to the tip of each lamella. The nerves of the lamellæ of each half of the group unite. The trunk thus formed unites with the nerves of the tentacles of the lobe of its own side and the common trunk enters the pedal ganglion near the median line. The tentacles of each lobe are largest near the outer end of the series. They grow smaller and smaller as the median line is approached; those nearest the median line are frequently so small as to be scarcely visible. At this point it is possible to find a complete series of gradations between the lamellæ of the median organ and the tentacles. The structure of the lamellæ confirms the suspicion that they are modified tentacles. This homology has been suggested by Van der Hoeven.

Between the bases of each two lamellæ is a pit lined by exceedingly slender epithelial cells. These cells are also from two to three times the height of ordinary epithelial cells. The cells bear cilia, apparently each cell bearing a single cilium; but the preservation of my material is not good enough for me to make sure of this point. Fine fibres appear to run from the bases of the cells into the tissues.

As has been said, Van der Hoeven's organ occupies the same place in the male that the inferior labial lobe occupies in the female. This organ is about 1 inch in length, $\frac{3}{4}$ inch in breadth, and $\frac{2}{3}$ inch in thickness. It is enveloped by a tunic, which, over the anterior dorsal half, is free from the organ, thus allowing free communication between the interior of the organ and the exterior. The anterior half of the organ is separated into halves by a narrow vertical slit which leads into the central cavity. This is a low horizontal cavity extending from side to side.

At the anterior end, on each side of the opening, are a number of low, thick, vertical lamellæ, which quickly pass into thin, broad, shelf-like, horizontal lamellæ, which extend as far back as the posterior limit of the vertical slit-like opening of the organ. Back of this point the organ is glandular; the glands completely surround the central cavity. The glands are typical examples of the compound-

tubular type. The epithelial cells of both glands and lamellæ are tall and cylindrical. The cells of the lamellæ are for the most part heavily loaded with secretory products. The cells of the glands are also loaded. Yet the lumens of the glands, as well as the central cavity, are entirely free from secretion, this evidently being stored in the cells till needed for some unusual purpose.

Another kind of cell is found among the epithelial cells of both glands and lamellæ. Around each epithelial cell are several fine hair-like sensory cells. The middle of each is swollen by the elongated oval nucleus. The tip of each cell is produced into a stiff sensory hair. The immense number of these cells bearing hairs makes the surface appear densely ciliated. The ordinary epithelial cells are of so much greater bulk than the sensory cells that close examination is required to reveal the fact that the cilia do not belong to them. I have seen the bases of the sensory cells continued for some distance into the submucous tissue as fine fibres of about the same diameter as the cell.

The nerves which innervate Van der Hoeven's organ have the same place of origin as those which innervate the inferior labial lobes of the female. One nerve enters each side of Van der Hoeven's organ and divides into a large number of branches. One of these runs into each lamella and several supply the glandular portion of the organ.

The number of lamellæ of Van der Hoeven's organ closely corresponds to the number of tentacles plus lamellæ of the inferior labial lobe. The innervation is the same in each, except that the nerve seems to form all its branches at one point in Van der Hoeven's organ, instead of at two points as in the labial lobe. The musculature of the one is the same as of the other. Willey finds that the same arteries supply both organs, and upon this fact bases the suggestion that they may be homologous. The sensory cells of Van der Hoeven's organ evidently correspond to those found between the bases of the lamellæ on the labial lobe; only in the one case they are restricted to definite areas, while in the other they are scattered throughout the organ. In short, anatomical evidence admits of no conclusion but that Van der Hoeven's organ of the male *Nautilus* is strictly homologous with the inferior labial lobe of the female *Nautilus*.

From the fact that the glandular cells in my sections of Van der Hoeven's organ are nearly all heavily loaded, and that absolutely no secretion is present in the lumens of the glands or in the central cavity of the organ, it appears that its glandular function may be limited to certain times and

conditions, possibly connected with reproductive processes. The sensory function is probably the same in both sexes and continually active, though it is possible that this also may be closely connected with reproduction.

The structure of the hectocotylus (or spadix) has recently been admirably described by Vayssière. Still, there are several points which may be added to his description.

The hectocotylus is composed of a group of four tentacles. These become highly modified. The organ is usually situated upon the left side; but in between twenty and twenty-five per cent. of my specimens it is upon the right side. In one case hectocotyli are upon both sides. On the opposite side of the animal from the hectocotylus is a similar group of four tentacles, but unmodified.

Three of the tentacles forming the hectocotylus are closely enveloped by a fleshy sheath, the fourth and smallest only partly. On the external side of the sheath at the margin is a circular glandular area. The glands are compound-tubular, branched quite simply; they extend, in a direction perpendicular to the surface, about three quarters of the distance through the sheath. Upon examining the corresponding portion of the sheath of the similar group of the opposite side I found a glandular area in the same position as that upon the sheath of the hectocotylus. The area is smaller, the glands are less developed, yet are exactly similar in structure. The presence of this gland on both groups of tentacles is extremely interesting, as it *may* indicate an original hectocotylization of both groups.

In the second tentacle of the hectocotylus (the tenth cirrus of Vayssière) is another interesting series of glands. This tentacle is annulated, the grooves being deepest upon the upperside. Into each groove upon this side opens a row of perfectly simple sac-like glands. The openings are exceedingly small and are well hidden in the depths of the grooves. A single layer of columnar epithelial cells lines the gland. The cells of the neck of the gland are low, but they rapidly increase in height as they pass into the gland, so that the body of the gland is lined by exceedingly high cylindrical cells.

[The valuable material upon which these notes are based was presented to the Department of Animal Biology of the University of Minnesota by Mr. Louis Menage, and I am greatly indebted to Professor Nachtrieb for placing it at my disposal.]

XXVII.—Description of a new Species of Gerrididæ.

By Dr. G. HORVÁTH.

Hygrotrechus Distanti, sp. n.

Supra niger, opacus, subtus dense argenteo-sericeus, subnitidus; vertice macula parva transversa basali aurantiaca notato; rostro apicem mesosterni vix attingente, toto nigro: antennis nigris, articulo primo articulis tribus apicalibus simul sumtis vix brevior, articulis secundo et quarto longitudine æqualibus, articulo tertio articulo præcelente fere $\frac{1}{4}$ brevior; pronoto capite quadruplo longiore, lineola longitudinali lobi antici marginibusque lateralibus et postico lobi postici aurantiacis, lobo postico transversim subrugoso; hemelytris rudimentariis, fortiter abbreviatis, apicem metanoti haud (σ) vel vix (ρ) attingentibus, lanceolatis, limbo externo basin versus nigricante; dorso abdominis linea mediana percurrente, interdum sat obsoleta, argenteo-sericea ornato; prosterno, parte inferiore acetabulorum et fulcrorum posteriorum apiceque imo coxarum posteriorum albidio-testaceis; pelibus nigris, femoribus intermediis femoribus posticis longitudine subæqualibus, tibiis et tarsis posticis simul sumtis tibiis intermediis paullo longioribus, articulo primo tarsorum anteriorum articulo secundo vix brevior; spinis apicalibus segmenti sexti abdominis gracilibus, acutissimis, nigris, nitidis.

σ . Meso- et metasterno vitta mediana angusta fusca signato; spinis apicalibus segmenti sexti abdominis segmento genitali primo $\frac{1}{4}$ brevioribus; segmentis ventrali sexto et genitali primo postice flavo-limbatis; segmento ventrali sexto postice emarginato, emarginatura medio profunde rotundato-sinuata; segmento genitali primo subtus trifoveolato, foveolis duabus lateralibus mediis et foveola antica in emarginatura mediana segmenti ventralis sexti sita sat profundis, inter se carinula trifida discretis. Long. $11\frac{1}{2}$ mill.

ρ . Spinis apicalibus segmenti sexti abdominis segmentum genitale primum fere dimidio superantibus; limbo postico segmenti ventralis sexti segmentoque genitali primo subtus flavo-testaceis; illo postice rotundato-emarginato, hoc utrinque prope basin leviter impresso. Long. $13\frac{1}{2}$ –14 mill.

Hab. Nyasaland, Fort Johnston.

This fine species, three specimens of which Mr. W. L. Distant has submitted to me for identification, differs from the other species of the genus by the yellow-margined pronotum, the orange-yellow rudimentary elytra, and the two joints of the anterior tarsi subequal in length.

XVIII.—*On some South-African Insects.*

By W. L. DISTANT.

I HAVE received some Longicorn beetles from the Rev. H. Junod, collected by him at Delagoa Bay, two of which appear to be undescribed and not included in the list of the Delagoa Longicornia recently published in these pages (ser. 7, vol. i. p. 378).

Among some Sphingidæ forwarded to me from the Pretoria Museum I found two apparently undescribed species from the Lydenburg District of the Transvaal, the diagnosis of which I take this opportunity to publish.

COLEOPTERA.

LONGICORNIA.

Fam. Cerambycidæ.

Hercodera marginata, sp. n.

Testaceous; head, pronotum, and femora reddish testaceous; eyes, antennæ, bases and apices of femora, tibiæ, and tarsi black; elytra with the anterior, apical, outer, and sutural margins and a transverse fascia beyond middle bluish black, apical margin broadest.

Head obsoletely punctured. Pronotum at the sides and above covered with broad, shallow, regular punctures, giving it a reticulated appearance. Elytra very thickly and strongly punctate, the transverse fascia widest at sutural and outer margins.

Long. (two specimens) 9 and 12 millim.

Hab. Delagoa Bay (*Junod*).

This is the second species of the genus yet described. It differs from *H. fasciata*, Gahan, by being less angular at sides of pronotum and also in the elytral markings. The punctures, as Mr. Gahan kindly informs me, are almost exactly alike in both species.

In the smaller specimen of the two on which this description is based the transverse fascia to the elytra is very narrow and somewhat indistinct.

Oxyprosopus delagoæ, sp. n.

Æruginous; eyes, antennæ, femora, and tibiæ black; tarsi pale fulvous.

Head at the anterior margin concave, with a distinct central impression. Pronotum narrowest at anterior margin, where it is transversely striate, gradually widening posteriorly, where it is obscurely angulated at lateral margins; base transversely striate, remainder of disk thickly and coarsely punctate. Elytra thickly and somewhat coarsely punctate, each elytron with two discal, longitudinal, slightly raised lines.

Long. 21 millim.

Hab. Delagoa Bay (*Junod*).

In one specimen the elytra are more or less cyaneous.

LEPIDOPTERA.

HETEROCERA.

Fam. Sphingidæ.

Polyptychus consanguineus, sp. n.

Body and legs fawn-coloured; head and pronotum with a central longitudinal smoky-brown fascia.

Anterior wings fawn-coloured, crossed by two narrow linear brown fasciæ—the first about one fourth from base, the second longest and more oblique beyond cell; between these fasciæ are two waved paler ones, placed somewhat close together, and two lines, giving the appearance of a subquadrate spot, at end of cell; some indistinct waved brown markings cross apical area of wing, and two small brown spots placed one above the other near apex of inner margin. Posterior wings fulvous, with two transverse brown linear markings just above inner angle at posterior margin, and with a small spot of the same colour beneath them. Wings beneath with two indistinct transverse fasciæ, one beyond cells, the other, more waved, near outer margins.

Exp. wings 60 millim.

Hab. Transvaal, Lydenburg District.

A near and very close ally of this species is to be found in the *P. Jankowskii*, Oberth., described from the island of Askold, off the north-east coast of Asia.

Polyptychus africanus, sp. n.

Body and legs fawn-coloured; front of head, lateral and posterior margins of pronotum dull olivaceous.

Anterior wings to end of cell and middle median nervule saffron-coloured, beyond this pale olivaceous; two small costal spots at base, a large longitudinal spot at base of inner

margin, a spot crossing centre of cell, a subquadrate apical spot, and a small one near apex of inner margin dark dull olivaceous. Posterior wings stramineous, olivaceously tinted towards margins, and with a curved dull olivaceous spot near the inner angle of posterior margin. Anterior wings beneath with the basal area ochraceous, the apical area olivaceous, spots absent; posterior wings beneath without spot; both wings crossed by two indistinct fasciæ, one beyond cell, the other near outer margin.

Exp. wings 72 millim.

Hab. Transvaal, Lydenburg District.

In colour and markings somewhat resembling *Mimas tilice*, Linn.

I have recently received from Delagoa Bay a specimen of *Panacra orphæus*, Herr.-Schäff., collected there by the Rev. H. Junod. This specimen I had previously, and with the advantage of the assistance of Sir G. H. Hampson, compared with *P. variolosa*, Walk., of which specimens both from the Andamans and India are in the British Museum. No real difference could be discovered between my South-African specimen and Walker's species, and we have apparently another hawk-moth common to the Ethiopian and Oriental regions. The synonymy should therefore stand as follows:—

Panacra orphæus, Herr.-Schäff.

Cherocampa orphæus, Herr.-Schäff. Aussereurop. Schmett. i. fig. 104 (1854); Boisd. Spec. Gén. Léop. Hét. i. p. 247 (1875).

Panacra variolosa, Walk. Cat. Lep. Hét. B. M. viii. p. 156, n. 4 (1856); Swinhoe, Cat. East. & Austr. Lep.-Hét. p. 13, n. 50, pl. i. fig. 4 (1892).

Panacra vagans, Butl. Ill. Lep. Hét. B. M. v. p. 4, t. lxxviii. fig. 7 (1881).

Panacra natalensis, Rothschild. Novit. Zool. vol. i. p. 79, pl. v. fig. 13 (1894).

Hab. S. Africa, N. India, Andaman Islands, Borneo.

XXIX.—On a Specimen of *Lepidopus atlanticus*, Goode & Bean, from *Madeira*. By G. A. BOULENGER, F.R.S.

THE British Museum has received, together with other fishes collected at Madeira by the late Mr. Axel J. Arendrup, and presented to the Trustees by his mother, a fine specimen, 1 metre 20 centim. in length, of a fish described and figured in

the 'Oceanic Ichthyology' (p. 205, fig. 215) under the name of *Benthodesmus atlanticus*. The species was founded on specimens obtained on the western edge of the Grand Bank of Newfoundland, off St. Kitts, W.I., and in mid-North Atlantic, at depths varying between 25 and 203 fathoms, and previously referred to *Lepidopus elongatus*, Clarke. I am now able to report its occurrence at Madeira and on the coast of Portugal, whence it has been inadequately described and figured by Vieira as *Lepidopus argenteus*, Bon. (Ann. Sc. Nat. Porto, i. 1894, p. 165, pls. ix. & x.).

Mr. Arendrup had fully realized the interest that attaches to the Madeira specimen, which represented an unnamed species at the time he obtained it, and he had drawn up some notes which I here reproduce in an abridged and slightly altered form, after verification on the original.

Depth of body 22 times in total length, length of head $6\frac{1}{2}$ times. Vent marking $\frac{2}{3}$ on the total length. Occipital crest very feeble; eye 6 times in head, $2\frac{1}{3}$ in snout; lower jaw projecting, with a fleshy appendage anteriorly; teeth acute, compressed, 19 in upper jaw (including 2 large anterior fangs), 20 in lower jaw, without any larger ones. 7 branchiostegals. Gill-rakers few, widely separated. Dorsal with about 156 rays, beginning halfway between eye and root of pectoral, the longest rays not quite so long as diameter of eye. Anal with 26 free rays. Ventrals represented by minute scale-like scutes. Pectoral 3 times in length of head. Caudal small, forked. Caudal peduncle depressed, 5 times in length of head. Uniform silvery; margin of dorsal black for the first 10 or 12 rays.

XXX.—On the Preliminary Stages and Mode of Escape of the Imago in the Dipterous Genus *Xylomyia*, Rond. (Subula, Mg. et auct.), with especial reference to *Xylomyia maculata*, F.; and on the Systematic Position of the Genus. By E. E. AUSTEN, Zoological Department, British Museum.

I.

PRELIMINARY STAGES AND MODE OF ESCAPE OF THE IMAGO.

THROUGH the courtesy of the Rev. H. S. Gorham the new collection of British Diptera in the National Museum has recently been enriched by a (σ) specimen of the rare fly *Xylomyia maculata*, F., together with its puparium and the skin of the pupa from which it was bred.

Xylomyia maculata is an extremely handsome insect, rather more than 9 millim. (4·5 lines) in length, shining black, with the thorax spotted and the abdomen banded with yellow, with yellow legs, the tips of the posterior femora and tibiæ broadly banded with black, and the ends of the tarsi infuscated. Mr. Gouham bred eleven specimens of the fly from pupæ found with some forty others on June 29, 1898, in a rotten oak-tree in the New Forest.

Mr. G. H. Verrall's 'List of British Diptera' (1888) includes three species of *Xylomyia*, of which two (*X. varia*, Mg., and *X. maculata*, F.) are printed in italics, as requiring confirmation, while the third (*X. marginata*, Mg.) appears in ordinary type, as an authenticated member of the British fauna. Of these three species, two (*maculata* and *varia*) are given by Walker, in the 'Insecta Britannica.—Diptera' (vol. i. 1851, p. 34), under *Subula* *. With reference to *X. maculata* Walker writes:—"Very rare; inhabits the New Forest, Hampshire. In Mr. Stephens's collection." While as to *varia* he says:—"Very rare. In the British Museum. The larva feeds on the wood of the oak."

A (♀) specimen of *Xylomyia maculata* (placed under *Xylophagus*, and labelled "*scutellata*?"), with a puparium in which the pupa-skin is sticking precisely as in our latest acquisition, is still contained in the Museum in the old Stephensian Collection of British Diptera, which also includes a male and female of what appears to be a variety of *X. varia*,

* The name *Subula*, as applied to a genus of Diptera, owes its origin to a note by Meigen published in 1820 (Syst. Besch. bek. europ. zweifl. Insekten, ii. p. 15), in which it is stated that Megerle v. Muhlfield forms the genus *Subula* out of Meigen's second division of the genus *Xylophagus*, comprising the three species (*maculatus*, F., *varius*, Mg., and *marginatus*, Mg.) mentioned above. *Subula*, however, is preoccupied, having been used by Schummel in 1817 for a genus of Mollusca, and in 1861 *Xylomyia* was proposed in its stead by Rondani (Dipt. Ital. Prodrum. iv. p. 11). This emendation was ignored by Schiner, both in his 'Fauna Austriaca' and 'Catalogus Systematicus Dipteriorum Europæ,' and, for some unknown reason, modern continental dipterists, such as Brauer and van der Wulp, still follow Schiner's lead. Osten Sacken, who noticed Rondani's name in 1856 (Biol. Centr.-Am., Dipt. i. p. 23), did not adopt it, since he was of the opinion that "a change in a name of such old standing involves much more inconvenience than its retention." In the face, however, of modern ideas on the subject of priority such an objection is scarcely valid, and it is safe to say that the sooner the name *Xylomyia* is definitely recognized the better. As indicated above, Rondani's designation was duly adopted by Verrall in his 'List'; yet van der Wulp ('Catalogue of the Described Diptera from South Asia': The Hague, Martinus Nijhoff, 1896, p. 46), while remarking that *Subula* is preoccupied, is apparently ignorant of the existence of Rondani's *Xylomyia*.

Mg., with the abdomen, with the exception of the semilunar depression at the base, entirely black and without the incisions between the segments being "very narrowly yellow," as described by Meigen*. As is unhappily the case throughout the Stephensian Collection, these three specimens are without locality-labels. *Xylomyia maculata* as a British insect was also known to Westwood, for in the 'Introduction to the Modern Classification of Insects,' vol. ii. (1840) p. 534, he writes:—"The Rev. F. W. Hope has also given me specimens of *Subula maculata* and its preparatory state; the latter found by him in a dry rotten tree in the New Forest, and from which he reared the imago. It is larger than that of *X. varia*, but does not otherwise differ from it." It will have been noticed that all the British examples of *Xylomyia maculata* hitherto recorded come from the same locality.

In Verrall's 'List' the genus *Xylomyia* is placed with *Xylophagus*, Mg., in the family Xylophagidæ; in Schiner's 'Fauna Austriaca' the same family is made to include a third genus, *Pachystomus*, Latr. (for *Rhagio syrphoides*, Pz.), which is stated by Osten Sacken (Berl. ent. Z. xxvi. (1882) p. 379) to be "nothing but a *Xylophagus* with broken antennæ." While, however, the differences between *Xylomyia* and *Xylophagus* are of more than generic rank even in the perfect state †, in the preliminary stages they are much more marked. Whereas the larvæ of *Xylomyia* as well as of *Xylophagus* live in the stumps and beneath the bark of dead

* *Xylomyia varia*, Mg., is a considerably smaller species than *X. maculata*, measuring only 5·3 to 7·3 millim. (3 to 3·5 lines) in length, instead of 9·3 millim. (4·5 lines), but the antennæ are longer; the dorsum of the thorax is without yellow markings, and the legs, except the tips of the tarsi, are yellow. *Xylomyia marginata*, Mg., is not represented in either of our collections of British Diptera; but two (♀) specimens from Germany in our general collection of Diptera show that, while agreeing in length with *X. varia*, it is a much broader and bulkier insect, and consequently, as regards size, occupies an intermediate position between *X. maculata* and *X. varia*. The antennæ are shorter than in the latter species; the thorax is without yellow markings on the dorsum and is not shining, being finely and closely punctured and clothed with very short yellowish hair, forming indistinct longitudinal stripes; the hind margins of the abdominal segments from the second to the fifth are narrowly yellow; the legs are yellow, with black coxæ, and the ends of the tarsi and the tips of the hind femora infuscated; the hind femora are distinctly swollen (which is not the case in the other two species), and bear a row of minute black tubercles on the distal half beneath; the venation is as in *X. varia*. In *X. maculata* the upper branch of the third vein is distinctly more slender than the main stem, and is shorter and flatter than in the other two species, while (as pointed out by Schiner) the first vein that leaves the discal cell is very strongly curved.

† Cf. O. Sacken, Berl. ent. Z. xxvi. p. 364 (referred to by Brauer, Denkschr. k. Akad. Wiss. Wien, Bd. xlvii. p. 23, note).

trees, those of the latter alone are carnivorous and prey upon beetle larvæ. The larva of *Xylophagus*, as described by Brauer (Denkschr. k. Akad. Wiss. Wien, Bd. xlvii. (1883) pp. 23-24, Taf. iv. figs. 80-83—*Xylophagus cinctus*, F.), is a cylindrical fleshy grub, with a parchment-like integument, a greatly elongated head (*Kieferkapsel*, Brauer), and with scute- or bands of chitin on the first ring or on the first three postcephalic rings; the pupa is obtectate (*Nymphe eine freie Mumienpuppe*, Brauer) *.

The larva of *Xylomyia*, on the other hand, is a very different-looking creature, which closely resembles that of certain well-known Stratiomyidæ, such as *Chloromyia formosa*, Scop., and *Actina tibialis*, Mg.† The dried larva-skin (puparium) of *Xylomyia maculata*, presented by Mr. Gorham, must, as in the case of ordinary Stratiomyid larvæ, be precisely similar to the living larva in shape and general appearance, owing to the hardness of the shell-like integument, which is covered with closely-set ovoid scales or plates, and does not admit of contraction. It is dark reddish brown in colour, slightly tapering towards the extremities and oval in transverse section; the lateral margins of the body-segments are expanded into tumid ridges. The head is very similar in general appearance to that of the larvæ of *Sargus*, *Chloromyia*, or *Actina*. Our larva-skin is 15·5 millim. (7·5 lines) in length and about 4·5 millim. (or just over 2 lines) in greatest breadth; it consists of eleven segments behind the head, and from the fifth to the eighth (postcephalic) segments the sides of the body are nearly parallel; the last segment, which is somewhat truncate, bears on its hind margin a pair of tumid lips enclosing a transverse horizontal cleft, in which open the posterior stigmata; the anterior stigmata are found in the usual position, one on each side of the first postcephalic (the prothoracic) segment. Apparently, therefore, the larva is

* The larva and pupa of *Xylophagus cinctus*, F., were described more than twenty years ago by the late Dr. F. Buchanan White ("Metamorphoses of *Xylophagus cinctus*, F., and *X. ater*, F.," by F. Buchanan White, M.D., F.L.S., Ent. Month. Mag. vol. xiii. (1876) pp. 160-162), who found the larvæ of both our British species of *Xylophagus* in Braemar—those of *X. cinctus* under the bark of dead fir-trees, and those of *X. ater* between the bark and wood of dead birch-stumps. The metamorphoses of *Xylophagus cinctus* have also been dealt with by Perris (Ann. Soc. Ent. Fr. sér. 4, t. x. (1870) pp. 202-205, pl. iii. figs. 70-79) in his paper on the "Insectes du Pin Maritime."

† Cf. a description of the larva of *Chlorisops (Actina) tibialis*, Mg., by Adam Handlirsch (Verh. z.-b. Ges. Wien, Bd. xxxiii. (1883) pp. 243-245, woodcuts in text); the author found the larvæ of this species in the middle of August near Modling, in Lower Austria, in forest-mould, mixed with much decaying vegetable matter.

amphipneustic, thus agreeing with the larvæ of *Xylophagus*, but differing from those of Stratiomyidæ. On each side, however, of the first six abdominal segments, immediately behind the tumid lateral ridge, and so in the angle which each segment forms with the next, I observe a small papilla. On examining the larva-skin with a microscope I cannot detect an aperture in any of these papillæ; but it seems in the highest degree probable that they represent stigmata which have disappeared, but were functional in the larvæ of ancestors of the existing species of *Xylomyia*. At any rate, on examining them one is involuntarily reminded of the arrangement of the stigmata in the larva of *Actina tibialis*, Mg., as described by Handlirsch (*loc. cit.* p. 243, in which it is stated that (besides the ordinary stigmata at each end of the body) there is a very small stigma on each side of the first six segments of the abdomen*.

The body of the larva is nearly bare; each postcephalic segment bears a stout recurved yellowish-brown hair on the tumid ridge on each side, and, in the case of the first ten segments, a transverse row consisting of six similar hairs on the dorsal side; there is also a similar row of hairs on the ventral side; the eleventh segment has two hairs on the upper-side, apparently four pairs beneath, and a pair, which curve forwards, on the posterior margin—one on each side between the lips of the stigmatic cavity and the posterior angle.

The larva-skin (puparium) of *Xylomyia maculata* agrees very closely with that of the American *Subula pallipes*, Lw., as described by C. H. Tyler Townsend (*Ent. News*, 1893, p. 164), except for the absence of the transverse rows of small tubercles stated by Townsend to occur on segments 5 (fourth postcephalic) to 11. In this connexion it is interesting to note that the integument of the larva of *Xylomyia varia* (*Xylophagus varius*), Mg., as described by von Roser †, and that of the sixth and following segments of the larva (larva-skin) of *Xylomyia marginata* (*Xylophagus marginatus*), Mg., as described by Wesmæl ‡, also bear transverse rows of

* Handlirsch appears to be unaware of the existence of the lateral papillæ in the larva of *Xylomyia*; at any rate, he merely states (*loc. cit.* p. 245):—"In *Subula* it has not yet been determined with absolute certainty whether the larva is likewise peripneustic, since the stigmata on the body are not easily recognizable, owing to the scale-like structure of the cuticle."

† Naturwiss. Abhandlungen, Stuttgart u. Tübingen, Bd. ii. Heft 2 (1828), p. 188.

‡ Cf. Ann. Soc. Ent. Fr. t. vi. (1837), Bulletin Entomologique, p. xc. According to L. Dufour (*Ann. Sc. Nat., Zoologie*, sér. 3, t. vii. (1847) p. 13), in the larva (larva-skin) of *X. marginata* all the abdominal segments bear transverse rows of tubercles. This author writes:—"Les

tubercles. Von Roser states that the segments have "a transverse row of from eight to ten dirty whitish-yellow round tubercles, each of which bears a small bristle of similar colour. A more numerous row of smaller tubercles is more or less distinctly visible at the base of the rings."

The most remarkable phenomenon presented by *Xylomyia*, apart from the striking resemblance of its larva to that of certain Stratiomyidæ, is the way in which the imago makes its escape from the pupa. As in ordinary Stratiomyidæ, pupation takes place within the dried larva-skin (puparium), which, owing to its hardness, doubtless affords an excellent protection; but, instead of the fly making its escape in the ordinary way from the anterior extremity of the puparium, leaving the pupa-skin behind it within the latter, the pupa itself, shortly before the imago emerges, makes its way partly out of the puparium through a longitudinal cleft which appears in the middle dorsal line of the second and third thoracic and first two abdominal segments. The pupa does not leave the puparium altogether, but its posterior extremity remains fixed in the cleft, and in this position the semi-transparent shining yellowish-brown pupa-skin is left sticking after the escape of the fly, which is no doubt facilitated by the fixation of the pupa-skin. The abdominal segments of the pupa, from the second to the sixth*, bear a transverse row of stiff, appressed, backwardly directed bristles, reddish brown in colour, and arranged in groups, each group having in the middle a bristle longer than the rest. The function of these bristles evidently is to assist the pupa in raising itself out of the puparium. For a more detailed account of the pupa the reader may be referred to Townsend's description of the pupa of *Subula pallipes*, Lw. (*loc. cit.* p. 165).

The fixture of the pupa (and pupa-skin after the escape of the fly) by the posterior extremity in the cleft in the pupa-

segments thoraciques sont tout à fait lisses, tandis que les suivants ont, tout près de leur bord antérieur, une série transversale de fort petites aspérités sous formes de points." The larva of *Xylomyia* (*Subula citripes*, Duf., as described by Dufour himself (*ibid.* pp. 7-8; cf. t. vi. pl. xvii. fig. 12), also has transverse rows of tubercles (a single row on the three thoracic segments and a double row—one of very minute tubercles near the anterior margin and another of larger tubercles towards the middle—on those of the abdomen). So far as we can judge at present, therefore, in the absence of tubercles the larva of *X. maculata* is unique.

* Townsend (*loc. cit.* p. 165) writes "segments 2-7" in the case of the pupa of *Subula pallipes*, Lw.; the statement may very possibly also apply to the pupa of *X. maculata*, but in the specimen before me I cannot trace the abdominal segments back beyond the sixth, as the remainder are hidden in the puparium.

rium is no mere accidental occurrence; on the contrary, it appears to be invariable in the genus *Xylomyia*. It was recorded seventy years ago by von Roser (*loc. cit.* p. 190) in the case of *Xylomyia varia* (*Xylophagus varius*), Mg., and one of von Roser's specimens showing this was given by him to Westwood, who mentions it in the 'Introduction' (vol. ii. p. 534), and illustrates it by a (very poor) figure (*op. cit.* p. 531, fig. 127, 14). Dufour, who bred some forty specimens of his species *Subula citripes*, actually witnessed the partial emergence of the pupa from the puparium and the subsequent escape of the fly; he describes how the pupa works its way out through the rent in the thoracic segments of the larva-skin until two thirds of its length project, and states that the "domino de la nymphe" may be found in the rent after the imago has left it*. Lastly, Townsend writes (*loc. cit.* pp. 163, 164) of *Subula pallipes*, Lw.:—"The pupa works itself more than halfway out through this opening [in the puparium], and there remains. The fly then escapes, leaving at least the posterior one third of the pupal skin still enclosed within the split portion of the puparium."

II.

SYSTEMATIC POSITION.

So long ago as 1882 it was shown by Osten Sacken that *Subula* (*Xylomyia*) could not be allowed to remain in the same family as *Xylophagus*, where most of the previous writers had been content to leave it, but that the original family Xylophagidæ must be dissolved, *Subula* being placed "among the Beridina, until its relationship is cleared up." Osten Sacken proceeded to say:—"Xylophagus and *Cænomyia* would form the stock of the reformed family Xylophagidæ, which must be brought in nearer connexion with the Leptidæ, and not with the Notacantha" †. Shortly before this Brauer had been led to a similar conclusion through study of the larvæ; he wrote ‡:—"In the Xylophagidæ we find two divisions, of which one (*Subula*), through the larva and its mode of pupation, reminds us of the true Stratiomyidæ, while the other (*Xylophagus*) recalls Tabanidæ and exhibits a free nymph." The remarkable external resemblance between the larvæ of *Xylomyia* and those of certain Stratiomyids

* Ann. Sc. Nat., Zoologie, sér. 3, t. vii. (1847) pp. 10-11, t. vi. pl. xvii. fig. 18.

† C. R. Osten Sacken, "On Professor Brauer's Paper: Versuch einer Charakteristik der Gattungen der Notacantha, 1882," Berl. ent. Z. Bd. xxvi. (1882) p. 365.

‡ Denkschr. k. Akad. Wiss. Wien, Bd. xlv. (1882) pp. 61-62.

(such as *Sargus*, *Chloromyia*, and *Actina*), as well as the agreement in the mode of pupation, has indeed attracted the attention of most authors who have studied the life-history of the various species. Thus, in 1828, von Roser (*loc. cit.* p. 188) declared the larva of *Xylophagus varius* (*Xylomyia varia*), Mg., to be very similar to that of *Stratiomys chamæleon*, excluding the tubular tail; Westwood writes ('Introduction' &c. ii. (1840) p. 535):—"The genus *Subula*, as discovered by M. van Roser and the Rev. F. W. Hope, has a metamorphosis exactly like *Sargus*, the pupa being enclosed within the unaltered larval skin, but the transformations of the typical *Xylophagi* are quite different"; Dufour (*loc. cit.* p. 7 (1847)) states that the larva of *Sargus leaumurii*, F. (= *Chrysonotus bipunctatus*, Scop.), appears to belong to the same class as that of *Subula citripes*, Duf.; and Perris (Ann. Soc. Ent. Fr. sér. 4, t. x. (1870) p. 206) alludes to the close resemblance in outward appearance between the larvæ of *Subula* and those of *Pachygaster* and *Sargus*. The agreement in general appearance and character of the integument between larvæ of *Xylomyia* and those of *Chloromyia* or *Actina* must in fact strike anyone, and to attempt to argue that such a remarkable external resemblance is due to mere *convergence*, brought about by adaptation to a similar mode of life, is manifestly out of the question. To refute such a suggestion it is only necessary to compare a larva of *Xylomyia* with that of *Xylophagus* or with any of the other dipterous larvæ to be found in the mouldering stumps of dead trees. It is true that the larvæ of *Xylomyia* appear to be amphipneustic, while those of *Stratiomyidæ* in general are peripneustic; but, according to Brauer, the number and position of the stigmata is a very variable character, which has arisen by adaptation in so far as these apertures are peripheral or merely polar. Moreover, as I have shown above, the larva of *Xylomyia* appears to exhibit distinct *vestiges* of peripheral stigmata.

With reference to the importance of insect larvæ as indicating affinities, Brauer writes*:—"To contemplate earlier developmental stages of animals is, however, to cast a glance at their pedigree, which is otherwise beyond our reach, and I have already shown in another place ("Betrachtungen über die Verwandlung der Insekten im Sinne der Descendenztheorie.—II.," Verh. z.-b. Ges. Wien, 1878, p. 151 *et seq.*) that even such *acquired* larval forms as those of the insects are adapted for this purpose *because they have become hereditary*."

There is no necessity to repeat the arguments (drawn from

* Denkschr. k. Akad. Wiss. Wien, Bd. xlvii. (1883) p. 3.

the imagines, larvæ, mode of pupation, and nervous system of the larvæ) used by Osten Sacken in his paper of 1882, to which reference has already been made, to divorce *Subula* from *Xylophagus* and substantiate its inclusion among the Stratiomyidæ (Beridina), especially as the paper in question is written in English. But it may be interesting to note that, as pointed out by Osten Sacken himself, his conclusions (at least so far as concerns *Subula*) were anticipated by Latreille and Westwood. The latter, in the 'Introduction' &c. vol. ii. pp. 533-534, and in the appended "Synopsis of the Genera of British Insects," p. 130, makes a family Beridæ, to include the genera *Subula*, *Beris*, and *Actina*, and another—the Cœnomyidæ—comprising *Xylophagus* and the non-British genera *Pachystomus* (= *Xylophagus*) and *Cœnomyia*. Westwood, however, erred in including his Cœnomyidæ among the Notacantha.

In 1891 Osten Sacken formally merged his Xylophagidæ (i. e. *Xylophagus* + *Cœnomyia*) in the Leptidæ, the death-warrant of the former family running as follows:—"The very problematic family of Xylophagidæ must be given up, and its contents, temporarily at least, united with the Leptidæ"*. Prior to this (in 1886—Biol. Centr.-Am.) Osten Sacken had placed *Subula* at the head of the family Stratiomyidæ; and in this connexion it may be remarked that the Beridina are placed by Osten Sacken at the commencement of the Stratiomyidæ† instead of at the end, where they (Berinæ) are to be found in Schiner's Catalogue as well as in Verrall's 'List,' and in one of the recent catalogues by van der Wulp‡. The position of *Xylomyia* at the commencement of the Stratiomyidæ instead of at the end is supported by a study of the venation, which exhibits several noteworthy divergences from the ordinary Stratiomyid type: it is sufficient to refer to the shape of the discal cell, which is very different from that which is a special characteristic of the Stratiomyidæ.

The conclusion, therefore, at which we arrive is that *Xylomyia* represents a primitive ancestral form of Stratiomyid, given off from the common stem after the evolution of

* C. R. Osten Sacken, "Suggestions towards a better Grouping of certain Families of the Order Diptera," Ent. Month. Mag. ser. 2, vol. ii. (1891) p. 38.

† Cf. 'Catalogue of the Described Diptera of North America' [2nd ed.], 1878, p. 43.

‡ V. d. Wulp, 'Catalogue Described Dipt. S. Asia' (1896), *supra cit.* p. 58. In the recently published 'Nieuwe Naamlijst van Nederlandsche Diptera, door F. M. van der Wulp en Dr. J. C. H. De Meijere.—Uitgegeven door de Nederlandsche Entomologische Vereeniging als Bijvoegsel tot deel xli. van het Tijdschrift voor Entomologie' ('S Gravenhage, Martinus Nijhoff, 1898), the first genus of the Stratiomyidæ is *Beris*.

the characteristic type of larva and mode of pupation, but before the assumption on the part of the imago of the equally characteristic features (venation, spurless tibiae *) exhibited by the more specialized types of the family; so that, in the present state of our knowledge, the only logical place for the genus is at the beginning of the Stratiomyidae †.

BIBLIOGRAPHICAL NOTICES.

The Study of Man. By ALFRED C. HADDON. 8vo. Pages xxxi and 512. With 49 Woodcuts and 8 Plates. Bliss and Co., London; Putnam and Sons, New York. 1898.

THIS comprehensive work on Anthropology, descriptive and illustrated, is a good introduction to that science, by Professor Haddon, D.Sc. &c., and is one of the "Progressive Science Series." The several subject-matters are treated as far as possible in a popular manner.

* The anterior tibiae in *Xylomyia* are always devoid of the apical spurs, with which the middle and posterior tibiae are normally armed; in certain exotic species, however, there appears to be a tendency towards the disappearance of the spurs on the posterior tibiae also, for in a species (at present undetermined) from Ceylon, collected and presented by Lt.-Col. Yerbury, the spurs on the hind tibiae are very small, while in *Xylomyia* (*Solva*) *hybotoides*, Walk., from Gilolo, they are apparently absent altogether.

† Lest it should be thought that, after what had previously been written by Osten Sacken and by Brauer, it was unnecessary to say anything further as to the question of the true systematic position of the genus *Xylomyia*, I may perhaps be permitted to point out that the conclusions of the authors in question appear to be ignored by recent writers and catalogue-makers. Verrall, as already stated, in his 'List of British Diptera' (1888), placed *Xylomyia* among the Xylophagidae, and his example is followed by van der Wulp in the two recently published catalogues of Diptera from South Asia and the Netherlands referred to above. Lastly, Williston, in his 'Manual of the Families and Genera of North American Diptera' (1896), p. 48, boldly places *Xylomyia* (the extraordinary misprint *Subula Omyia*, which represents the genus on the page referred to, is noted in the "Corrigenda" on p. iv, where Rondani's designation is substituted) among the Leptidae, uniting it with the American genera *Glutops*, Burgess, and *Arthroceras*, Williston, to form the subfamily Arthroceratinae. Unfortunately I cannot claim personal acquaintance with either of these genera, but (as is evident from the statements of their authors) they are so different from *Xylomyia* in general habitus—not to mention the fact that in them the marginal vein encompasses the entire border of the wing—that it is difficult to understand how anyone could place *Xylomyia* in the same subfamily. Williston, however, appears to think that in *Xylomyia* also the marginal vein runs right round the wing (cf. 'Entomologica Americana,' vol. i. (1885-86) p. 115), whereas as a matter of fact it stops short at the third vein, or at any rate does not extend beyond the second vein which issues from the discal cell.

On the whole, therefore, it seemed worth while to utilize this opportunity for once more drawing attention to the facts: that a genus should have been assigned to three families by contemporary writers is scarcely creditable to the present condition of dipterology.

Whether dealing with civilized or with savage life, and with the many representatives of various kinds and conditions of men in different stages of culture, it is desirable to know how and why the several people either agree or disagree one with another in their habits of life and modes of thought. It is then possible to meet them in their friendly advances with some satisfaction, or, if in unfriendly aspects, without mutual harm. So in a siege, a knowledge of the structure and bearings of a fortress enables the approach to be made with precision and advantage.

To characterize one man in a family, or a particular family in a tribe, or a tribe in a nation, or one nation as distinct from another, it is necessary to have a clear knowledge of the bodily features and the mental peculiarities of the individual and of the community, whether limited or numerous.

The method of discriminating the individual and national characters of past and present peoples can be carried out by definitely noting the measurements and proportions of the limbs, the shape and size of the skull, including face, nose, and ears; also the colour of eyes and hair. How these points can be usefully considered and brought to bear on the determination, discrimination, and classification of individuals and of national groups, the interesting book before us is designed to illustrate. The several physical characters and features alluded to above are dealt with in detail, beginning with the importance of measurements, particularly of the head, arm, hand, fingers, ears, and nose, in the identification of criminals.

To recognize the nature and relationship of bygone peoples—whether prehistoric, primæval, and possibly almost primitive, such as those who had nothing but stone for tools and weapons, or the bronze-workers, or those who used iron—we must look for some characters in their implements, in their skulls and other bones, and the relics of the animals associated with them in their caves and rock-shelters. Further, the drawings and carvings on the walls of their cave-dwellings, and in the more elaborate tombs, give useful indications of their doings and of others living with them as slaves or otherwise. Their heaps of refuse, their mounds of sepulture and perhaps of religious meaning, are also witnesses of their life and death, their habits, intentions, and aspirations.

In the early chapters of this volume the ancient Egyptians, Assyrians, Babylonians, and Lybians, as well as the old and the modern Jews, the British, French, and some other European peoples, are all shown to yield evidences of racial and other relationships when studied as to structural details and habits of life.

Previous, however, to the monumental and documentary evidences of Chaldæa and Egypt, many widespread peoples had left distinct traces of their whereabouts, their doings, and their sentiments.

The systematic study of Man and Mankind, now known as the science of Anthropology, is closely associated, on the one hand, with Archæology, which leans on Geology for the explanation of some of its most important problems, and, on the other hand, when directed to the elucidation of the natural grouping, origins, and migrations of tribes or nations, it becomes Ethnology and Ethnography, com-

prising Sociology, Technology, Religion, Linguistics. and Folk-lore. Physical and experimental Anthropology, or Somatology, treats of the nature and structure of the body, anatomically and physiologically.

By means of Anthropology we recognize a very high antiquity of the human race, its wide extension in early times, and the successive evolution of better types along certain lines, with varied stages of culture, in their rise, maturation, and decadence.

Chapter V. illustrates the plan, details, and conclusions of an ethnographic study of the inhabitants of a certain district, namely, a part of West-Central and South-west France, comprising the five Departments of Dordogne, Charente, Corrèze, Creuse, and Haute Vienne. These notes are based on the data published by Dr. Collignon in 1894 and 1895. Statistics and diagram-maps illustrate the local distribution of special characters of the cranium, colour of hair and eyes, and the stature.

Under the technical terms of brachycephalic and dolichocephalic (as determined from the relative length, breadth, and height of the skull), the inhabitants of this region are found to represent, on the one hand, (1) short and dark, or (2) tall and fair brachycephals, and, on the other hand, (3) fair and tall, or (4) dark dolichocephals. Attention is drawn to the relationship of these several races and their varieties to the ancient peoples of Europe and the Mediterranean borders, and to the prehistoric folk or cave-men, of whom there are abundant remains in Dordogne. Evidences of the persistence of some of these races to the present day are traceable in the peasantry of certain cantons.

Some generalizations respecting the succession of races as inhabitants of this part of Western Europe are given in brief at pages 155-160. Scattered examples of a type probably related to the Man of the older stone-age have been observed. Early neolithic Man, inhabiting some of the caves, was probably the same as those known as the brown dolichocephals or Iberians. Short dark brachycephals came into the French region, probably by two routes, from the East in Neolithic times. Afterwards, as generally known, the fair dolichocephals ("Kymri, Gauls, Cimbrians, Burgundians, Visigoths, Franks, &c.") came from the north or north-east, first into the plains of North Germany, thence to what are now the Netherlands and Flanders. Divided by the Central Plateau of France, one branch streamed away into Italy, and the other into Spain, and thence to North Africa.

Under the heading of Technology or practical Ethnography, dealing with the history of tools and other manufactured objects, the author takes, as a familiar illustration of the gradual progress and practical working out of ideas in adaptation to circumstances, the history of the cart or wheeled vehicle, from its beginning as two parallel sloping poles, without wheels or any receptacle for goods—a condition not long since existing in Ireland and at present among American Indians when shifting their wigwams.

There are careful notices of the persistence of special toys and

games among children of many races, in unconscious continuation of the early use of certain weapons and kinds of warfare, or of manual work, of superstitions, and of gambling.

Much is collected in these chapters about the scratch-cradle and its meanings, about kites, tops, and tug-of-war game, and especially about the whirring, whizzing, buzzing, booming, perforated stick, whirled violently around with a string. This (known as the "Bull-roarer") is recognized as the ancient widespread ceremonial implement, once awing the superstitious, and still important in the hands of the conductors of the rites of Initiation in Australia. Children's singing-games are mainly concerned with courtship, marriage, funeral rites, and belief in ghosts, evidently (though distantly) representing ancient customs and lines of thought, in some cases still surviving in full force among savages and, in feebler fashion, among civilized communities.

Chapter XVI., pages 434-467, reprints the "practical suggestions for conducting ethnographical investigations in the British Islands," and includes at pages 467-489 "Instructions for the Collection of Folk-lore," an important branch of the science.

Appendix A consists of Dr. D. G. Brinton's comprehensive and very useful Classification and International Nomenclature of the Anthropological Sciences, namely:—(1) Somatology, (2) Ethnology, (3) Ethnography, (4) Archaeology, and their subdivisions. A careful Index completes this well-considered and welcome addition to the library of both the experienced scientist and of the general reader who wishes to enlarge his knowledge, feeling assured that a careful systematic study of Mankind is a good and proper object for the cultivated intellect of Man.

Trouessart's Catalogue of Mammals.

Catalogus Mammalium, tam viventium quam fossilium. By E. L. TROUËSSART. Parts IV. and V., containing the Orders Tillodontia, Ungulata, Sirenia, Cetacea, Edentata, Marsupialia, and Monotremata. Berlin: Friedländer and Son, 1898.

WITH the exception of the Addenda and Index Dr. Trouessart has now completed his stupendous task; and all naturalists owe him a debt of gratitude, the extent of which it is almost impossible to express in words. Till he had this work to refer to, it was in many cases a matter of extreme difficulty for the zoologist or palæontologist to discover how many species (whether valid or nominal) of a particular group had been named; but for the future all is comparatively plain sailing.

That the work has faults is, as we have pointed out in previous notices, from the nature of the case, inevitable; but the marvel is that these faults and omissions are so few and far between. To have enabled him to complete his labour Dr. Trouessart must possess patience and industry far above the average, while he has also the technical knowledge of his subject which raises his work to

a much higher level than the efforts of the mere compiler and bibliographer. In the name of our fellow students of recent and fossil mammals, we beg to tender to the learned author our most hearty congratulations and thanks.

As the Ungulata happen to be a group with which the reviewer has a more extensive acquaintance than he possesses of some of the other mammalian orders, such critical observations as seem necessary may be restricted to that group.

One of the first points that strikes us is that the author has not been sufficiently bold in relegating to the rank of synonyms names which have clearly no right to stand by themselves. Secondly, it is not quite easy to understand the method he has adopted in the selection of the generic names he employs. Take the instance of the true American deer, all of which are included in the genus *Cariacus*, with several subgeneric divisions. Now he admits that *Cariacus* is antedated by *Dorcylaphus*, while he further states that both are antedated by *Mazama* of H. Smith; but he adds that this latter is not the same as *Mazama* of Rafinesque, which is earlier than all. And yet on page 597 the *Mazama* of Rafinesque is admitted as identical with *Coassus*, which is itself one of the subgenera of *Cariacus*. Accordingly the latter term has no sort of justification for its retention, while if all the exclusively American groups of deer, with the exception of the pudus, are to be included in a single genus, that genus must, it would seem, be *Mazama*, if priority is to be regarded at all.

That these American deer are best included in a single genus, with subgeneric divisions, we quite agree, and we also hold with the author in arranging the majority of the deer of the Old World in the single genus *Cervus*, with analogous subgenera. But when this course is adopted it appears to us clear that the oxen should be treated in a similar manner; whereas we find the author employing terms like *Bibos* and *Bison* in a generic instead of a subgeneric sense.

Although, as will be evident from these remarks, we have a preference, and that a strong one, it is, to our thinking, a matter of small moment whether generic terms are used in a broad or a restricted sense. Yet it is a matter of importance that some degree of uniformity in such usage should be maintained in allied groups. This, we submit, is not the case with Dr. Trouessart's classification of the Pecora.

Again, he does not maintain a uniform practice with regard to the "*Scomber scomber*" principle. While we have, for instance, on page 829 the babirusa figuring as *Babirussa babirussa*, we find the roebuck (p. 888) appearing as *Capreolus caprea*, in spite of the fact that *capreolus* was the Linnean specific name of the latter. Here, again, one or the other course should be adopted and uniformly adhered to.

All the foregoing instances refer to classificatory matters, which are, after all, more or less dependent on individual opinion. On page 881 we find, however, the author deliberately going out of his

way to contradict well-known authors on a matter of fact. We refer to the inclusion of the Altai wapiti (*Cervus ensu^{ph}anus* of Blanford) as a synonym of the Persian red deer (*C. marul*). A greater blunder could hardly have been committed.

Neither is the work quite free from misprints, as witness *Rucercus* for *Rucervus*, on page 575.

Nevertheless, as already said, the blemishes and faults are but few, while good work is pre-eminently conspicuous; and we therefore close this brief notice with a repetition of the sense of the obligation under which Dr. Trouessart has placed all working students of the Mammalia.

R. L.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 9th, 1898.—W. Whitaker, B.A., F.R.S.,
President, in the Chair.

The following communication was read:—

'On the Palæozoic Radiolarian Rocks of New South Wales.'
By Prof. T. W. Edgeworth David, B.A., F.G.S., and E. F. Pittman,
Esq., Assoc.R.S.M., Government Geologist, New South Wales.

The first evidence of the presence of radiolaria in the rocks of New South Wales was obtained by Prof. David in 1895, as the result of a microscopic examination of some red jaspers from different areas. Further research by the same author was stimulated and guided by seeing the radiolarian rocks recently discovered in Mullion Island, Cornwall, and in the Culm-districts of Devonshire, during a visit to England in 1896; and on his return to Sydney he recognized the existence of a series of cherts, lydites, and siliceous limestones containing radiolaria in four distinct areas. A brief preliminary account of these rocks was communicated to the Linnean Society of New South Wales, and specimens were forwarded to Dr. G. J. Hinde for determination of the radiolaria. Subsequently, in conjunction with Mr. Pittman, a detailed examination of the rocks in the field was carried out, and the results are given in the present paper. In this final investigation it was ascertained that not only in the cherts and siliceous limestones, but also in the jointed claystones which form the prevalent sedimentary rocks of the Tamworth district, radiolaria were distributed in vast numbers.

The three chief areas of radiolarian rocks in New South Wales are Bingara, Barraba, and Tamworth, situated in the New England District, between 180 and 270 miles north of Sydney. Bingara, the farthest locality, is 30 miles north of Barraba; and this latter is 60 miles north of Tamworth. The character of the rocks in these localities tends to show that they belong to the same series; and in this case its extension from south to north is about 85 miles.

The fourth area of radiolarian rocks is at the well-known Jenolan Caves, about 67 miles due west of Sydney and about 200 miles south-by-west of Tamworth. It is probable that the Jenolan rocks may be on a somewhat different, perhaps lower, horizon than those of the northern district.

At Bingara and Barraba the radiolarian rocks consist of red jaspers and fine-grained jointed claystones, accompanied by thick coral-limestones and numerous beds of interstratified tufaceous materials. The radiolaria occur as casts in chalcedony in the jaspers and claystones. The rocks dip at a high angle. No macroscopic fossils are known with certainty from these districts.

In the Jenolan Cave district the radiolarian rocks consist of black cherts and clay-shales overlying the Cave Coral Limestone, and of greenish-grey shales underlying this rock. The series is traversed by felsitic dykes, and the hardness of the cherts is attributed to silica derived from the acidic dykes, rather than to that derived from the tests of the siliceous organisms.

It is at Tamworth that the radiolarian rocks are developed on a grand scale; their measured thickness amounts to 9267 feet, after allowing for an immense fault, and neither upward nor downward limit is shown. The rocks consist of jointed claystones, black cherts, lenticular siliceous radiolarian limestones, and coral-limestones. Numerous beds of submarine tuff also occur. The claystones are largely formed of radiolaria. In certain beds of the claystones, and in some of the tuffs as well, impressions of *Lepidodendron australe* are not uncommon; and beds of radiolarian limestone occur in close proximity to the beds with these plant-remains, and radiolaria moreover abound even in the same rock with the *Lepidodendron*-impressions.

At the eastern end of the Tamworth section, and also near the westerly portion, there are limestones containing corals, which have been determined by Mr. R. Etheridge, jun. They are similar to those of the Burdekin Limestones of Queensland which belong to the Middle Devonian, and the radiolarian rocks are thus shown to belong to this period.

Analyses of the radiolarian chert, cherty shale, shale, and siliceous limestone prepared by Mr. J. C. H. Mingaye, F.C.S., are given; and from these it appears that, while the amount of silica in the chert and shale ranges between 68 and 91 per cent., there is only 18 per cent. in the siliceous limestone.

Descriptions of numerous micro-sections both of the sedimentary and of the tufaceous rocks are appended, and in their conclusions the Authors point to the remarkably fine-grained character of the materials forming the base of the radiolarian cherts, jaspers, and shales, the constituent particles not being more than 0.05-0.025 mm. ($\frac{1}{500}$ to $\frac{1}{1000}$ inch) in diameter. They are of opinion that the radiolaria were deposited in clear sea-water, which, though sufficiently far from land to be beyond the reach of any but the finest sediment, was nevertheless probably not of very considerable depth.

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 15. MARCH 1899.

XXXI.—*Note on the Sexual Characters of Ligia oceanica.* By
CHARLES CHILTON, M.A., D.Sc., M.B., C.M., F.L.S.,
Research Fellow, Edinburgh University.

[Plate VIII.]

WHILE investigating some Australasian species of *Ligia* recently I found that in two of the species there were well-marked differences between the male and the female in the character of the anterior appendages of the peræon. It is probable that such differences are fairly common in the Ligiidæ, though in consequence of the general uniformity of the peræonal appendages in this family, and of the fact that they are largely concealed beneath the body and have not been hitherto much used in specific descriptions, these differences are not very prominent and may be readily overlooked. For the purpose of comparison I examined specimens of *Ligia oceanica*, and found that there are similar differences in this species also, both in the anterior peræopoda and, to a less degree, in the antennæ; and as I cannot find that anyone has drawn special attention to these sexual differences in this species, I now briefly describe them.

Bate and Westwood say:—"The male is much larger than
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the female, and is generally of a paler and less varied colour"*. Budde-Lund gives the dimensions as "Long. 20-28 mm.; lat., ♂ 8-10 mm., ♀ 10-14 mm.; alt. 3.5-5 mm."†; but, so far as I can ascertain, gives no difference beyond this one in width, while Sars, on the other hand, speaks only of a difference in length, saying, "Length of adult female 20 mm., of male up to 28 mm."‡ Dollfus, in his paper on the distribution of the genus *Ligia*, says:—"Les femelles, plus petites, sont généralement plus nombreuses que les mâles"§.

If we turn to other species of *Ligia*, our recorded knowledge of the differences between the male and female does not seem to be much more complete. Budde-Lund gives very brief descriptions of the first pair of legs in the male in *Ligia occidentalis*, *L. cinerascens*, *L. exotica*, *L. Olfersii*, and *L. dentipes*, but does not state in what respect these appendages differ from those of the female; in the case of *L. exotica* he mentions also that in the male the uropods are three fourths the length of the body, but in the female scarcely two thirds||. Dollfus has also drawn attention to the differences between the sexes in *L. exotica* as regards the first pair of legs, and has figured the extremities of these legs in the typical form and also in specimens from Bermuda, for which he has established the variety *hirtitarsis*¶.

In the nearly allied family of the Trichoniscidæ we find that sexual differences have been described in *Trichoniscus roseus* by Max Weber** and Sars†† among others, though, in keeping with that fickleness which so often characterizes these differences, here it is the seventh pair of legs, and not the first, that is specially modified in the male.

Dollfus has described and figured a remarkable enlargement of the extremity of the first, third, and fourth legs in *Philoscia anomala*, and has given references to similar modification in other species of *Philoscia*. In the case of *P. anomala*, since the enlargement was found in some of the males only, he thinks that it is perhaps a temporary character fully

* 'British Sessile-eyed Crustacea,' ii. p. 416.

† 'Crustacea Isopoda Terrestria,' p. 260.

‡ 'Crustacea of Norway,' II. Isopoda, p. 156.

§ 'Feuille des jeunes Naturalistes,' sér. iii. no. 278.

|| 'Crustacea Isopoda Terrestria,' pp. 264-268.

¶ "Isopodes terrestres du 'Challenger,'" Société d'Etudes scientifiques de Paris, xii.^e année, p. 8.

** "Anatomisches über Trichonisciden," Archiv für mikroskop. Anat. Bd. xix. p. 624 &c.

†† 'Crustacea of Norway,' II. Isopoda, p. 163.

developed only at the pairing-season*. Later on he described a similar modification in the first pair of legs in the male of *Philoscia variegata* from Venezuela†.

Probably similar differences will be found to exist in many other species of Terrestrial Isopoda, and may have been recorded; but the above references, for some of which I have to thank the Rev. T. R. R. Stebbing and Monsieur Adrien Dollfus, are all that I have so far been able to find on the subject.

In *Ligia oceanica* the male when fully adult is, as has been already stated by other authors, usually larger than the female; but though the female, when its brood-pouch is fully distended with eggs or young, may be wider in proportion than the male, this does not seem to be always so, for in the case of the specimens specially examined and drawn for this paper the male was 25 millim. long and 12 millim. wide, while the female was 24 millim. long but only 10 millim. broad, though the brood-pouch was well filled with eggs.

The outer antennæ show some slight differences in the two sexes, being appreciably stouter in the male both in the peduncle and in the flagellum. This will be seen on comparison of figs. 1 *ant* and 2 *ant* (Pl. VIII.), which are taken from male and females of nearly the same size, and are magnified to approximately the same amount. In the female the antennæ are sometimes slightly more spiny than in the male, but I have not been able to make out any constant differences in the proportions of the various joints. I was in the museum of the Dundee University College when the greater stoutness of the antennæ of the male was first noticed, and Mr. Calman and I then went over a large number of specimens in the collections of the museum, and found that in fully adult specimens we could correctly separate the males and females by the characters of the antennæ alone; in smaller and immature specimens the differences are naturally not so marked.

When we turn to the appendages of the peræon we find that there are slight modifications in the male in the first, second, and third pairs. As these three pairs differ from one another only in the fact that each is very slightly longer than the preceding, I have drawn only the second pair (fig. 1 *prp*²).

* *L. c.* p. 5.

† Extrait des 'Annales de la Société Entomologique de France,' vol. lxii. p. 343.

On comparison of this with fig. 2 *prp*², which represents the same appendage in the female, it will be seen that in the male the meros, carpus, and propodos are all produced on the inner side into a flat plate-like expansion, with the free border more or less convex and fringed with short setæ; on the anterior surface this expansion is on a level with the rest of the joint, but on the posterior aspect (shown in fig. 1 *prp*²) the cylindrical portion of each joint can be seen and the plate-like character of the expansion thus rendered more evident. On examination with a high power each expansion shows on its surface rows of small serrations, giving it an appearance like that of a file; and further magnification shows that this is due to closely-set rows of minute setæ. In the female there is no trace of these expansions, and the inner border of the different joints, more especially of the meros and carpus, bear numerous stiff setæ, which are larger and more irregular in size than those found in the corresponding positions in the male.

In order to make this short paper on the sexual characters of *Ligia oceanica* somewhat more complete, I have given figures of the first and second pleopoda of the male. These have been already drawn and briefly described by Sars*, and as their form can be readily made out from the figures, a detailed description is not here necessary. In the second pleopod (Pl. VIII. fig. 1 *plp*²) the whole of the endopodite appears to be modified into a two-jointed styloform organ, moved by powerful muscles; its second joint is long and cylindrical, and along with the external male organ proper (which is figured in connexion with the first pleopod in fig. 1 *plp*¹) no doubt forms a channel for the passage of the spermatozoa; its extremity is roughened on the inner side from the presence of numerous closely-set short setæ.

In both pleopods is seen a more or less oval plate, external to the exopodite and arising apparently from the outer part of the basal portion of the pleopod; in the case of the second pleopod its margin is fringed with fine setæ. This plate has been figured by Sars in this and in other species of the Oniscoidea, but I cannot find any special reference to it, and I am not quite certain as to its exact homology and significance; it appears, however, to correspond with a similar plate found on the third, fourth, and fifth pleopoda in the species of

* 'Crustacea of Norway,' II. Isopoda, p. 155, pl. lxx, figs. *plp*¹ ♂ and *plp*² ♂.

Phreatoicus which I have elsewhere suggested may be looked upon as an "epipodite" *.

This paper was commenced in the zoological laboratory of University College, Dundee; and I have to record my best thanks to Professor d'Arcy W. Thompson, C.B., for kind permission to make free use of his collections, and to Mr. W. T. Calman for assistance in this and other matters.

EXPLANATION OF PLATE VIII.

- Fig. 1 ant.* Outer antenna of a male specimen of *Ligiæ oceanica*, 25 mm. long and 12 mm. broad. $\times 6$.
Fig. 1 prp². Second perieopod of the same specimen. $\times 9$.
Fig. 2 ant. Outer antenna of a female specimen, 24 mm. long, 10 mm. broad (brood-pouch full of eggs). $\times 6$.
Fig. 2 prp². Second perieopod of the same specimen. $\times 9$.
Fig. 1 plp¹. First pleopod of male, posterior aspect. $\times 19$.
Fig. 1 plp². Second pleopod of male, posterior aspect. $\times 19$.

XXXII.—*A Revision of the Pierine Genus Huphina, with Notes on the Seasonal Phases and Descriptions of new Species.* By ARTHUR G. BUTLER, Ph.D., F.L.S., F.Z.S., &c.

THE present genus is one of the most pleasing in the subfamily Pierinæ. It is related to *Ganoris* and *Pinacopteryx*, but some of the species show apparent affinity to *Catophaga* (from which, however, the absence of the anal tuft in the males would readily serve to distinguish this sex). It separates into two well-defined groups, the first of which commences with forms resembling *Catophaga* and having well-defined seasonal phases, but terminates with forms more nearly resembling *Delias* in which seasonal phases are possibly non-existent. The second group in its colouring reminds one of *Delias*, *Catopsilia*, and *Ganoris*, but concludes with species having an under-surface colouring peculiar to this genus alone. The seasonal phases when known are less pronounced in their distinctive characters than in the earlier forms of the first group, and vary somewhat in the subgroups having the coloration of the genera above noted; those which remind one of *Delias* seem to have no defined seasonal phases.

* See Trans. Linn. Soc., Zool. ser. 2, vol. vi. part 2, pp. 195 & 208; and 'Records of the Australian Museum,' vol. i. p. 164.

Group I.

1. *Huphina inopinata*.

Belenois inopinata, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. xi. p. 380 (1883).

Wet phase, Fiji. ♂ type, ♀ ♀ (S. & G. coll.), B. M.

2. *Huphina acrisa*.

Pieris acrisa, Boisduval, Bull. Soc. Ent. France, 1859, p. clvi.

Belenois terranea, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xx. p. 356 (1877).

Lifu, Loyalty group. Type, B. M.

H. acrisa was described from the extreme wet form of the male, in which the under surface of the wings is white. A second (perhaps later) wet form has the apex of the primaries and whole ground-colour of the secondaries sulphur-yellow. The intermediate form has the same parts sordid buff-brownish, with the dark markings less pronounced, and, finally, the dry form (*H. terranea*) has these parts earthy brown. Owing to the acquisition of five examples, including two females, in the Godman and Salvin series, we now have all the phases; previously we only possessed males of the extreme types—*H. acrisa* and *terranea*.

Tachyris maculata, Grose-Smith, seems nearly allied to this, but I have not seen the type.

3. *Huphina perimale*.

♀. *Papilio perimale*, Donovan, Ins. New Holl. pl. xx. fig. 1 (1805).

♂. *Pieris pericleu*, Wallace (not Felder), Trans. Ent. Soc. ser. 3, vol. iv. p. 333 (1867).

♀. *Tachyris amarella*, Wallace, t. c. p. 373, pl. ix. fig. 2 (1867).

♂ ♂, ♀ ♀, New Caledonia (♀, Wallace's type). B. M.

The wet phase, with yellow under surface to secondaries, is in the Hewitson collection; *H. amarella* is the female of the intermediate phase, and typical *H. perimale*, with deep earth-brown under surface to secondaries, is the dry phase. In the females the width of the black borders above varies seasonally, being least developed in the dry form.

4. *Huphina scyllara*.

Pieris scyllara, McLeay, King's Surv. Austral., App. p. 459 (1827).

Pieris lanassa, Boisduval, Sp. Gén. Léop. i. p. 477 (1836).

Pieris nabis, Lucas, Rev. et Mag. de Zool. 1852, p. 326.

Pieris perithea, Felder, Reise der Nov., Lep. ii. p. 169 (1865).

Pieris periclea, Felder, l. c.

Pieris nices, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 333, pl. vi. fig. 3 (1867).

Australia, Baudin Island, &c. Fifty-three examples, B. M.

H. scyllara is the extreme wet phase, with white under surface to the secondaries; a second wet phase has these wings pale lemon-yellow below; a third (*H. nabis*) has them bright narcissus-yellow, and a fourth (*H. lanassa*) saffron-yellow. In *H. periclea*, the intermediate phase, they are buff-brownish, and in *H. narses*, the dry phase, earthy brown. During his visits to Baudin Island Mr. J. J. Walker obtained the whole of these variations.

5. *Huphina Kühni*.

Pieris Kühni, Rüber, C. B. Iris, p. 20, pl. i. figs. 2, 3 (1885).

Island of Kabia, Celebes.

Near *H. scyllara*; the black border of the male narrower, the secondaries of the female sulphur-yellow.

6. *Huphina rachel*.

Pieris rachel, Boisduval, Sp. Gén. Léop. i. p. 469 (1836).

Wet phase, Java (S. & G. coll.). ♂♂, B. M.

7. *Huphina discolor*.

Pieris discolor, Mathew, Trans. Ent. Soc. 1887, p. 47.

Ugi and Ulana, Solomon group. Types, B. M.

We received this fine species from the Godman and Salvin collection.

8. *Huphina agnata*.

Pieris agnata, Grose-Smith, Ent. Month. Mag. xxv. p. 301 (1889).

Guadalcanar and Ulana, Solomon group. B. M.

Eight examples of this species were received from the Godman and Salvin collection; it is exactly intermediate between *H. discolor* and *H. Wallaceana*, but differs from both in the absence of any subapical spot on the upper surface of the primaries.

9. *Huphina Wallaceana*.

Pieris Wallaceana, Felder, Reise der Nov., Lep. ii. p. 168 (1865).

Waigiou. ♂, B. M.

10. *Huphina pygmæa*.

Pieris pitys, var. *pygmæa*, Röber, Tijd. voor Ent. xxxiv. p. 279 (1891).

Wetter and Damma Island. ♂♂, B. M.

In our examples the border of the secondaries is narrower than in *H. pitys*. I believe this to be Herr Röber's species.

11. *Huphina perictione*.

Pieris perictione, Felder, Reise der Nov., Lep. ii. p. 168 (1865).

Aru.

Appears to be one of the links between *H. Wallaceana* and *H. pitys*.

12. *Huphina pitys*.

Pieris pitys, Godart, Enc. Méth. ix. p. 134 (1819); Lucas, Lep. Exot. pl. xxix. fig. 1 (1835).

Timor, Kaping, Sema, Dili, Java. B. M.

I cannot help thinking that Herr Röber must have wrongly identified this species, confounding examples of typical *H. pitys* with his *H. pygmæa*.

13. *Huphina consanguis*.

Belenois consanguis, Butler, P. Z. S. 1883, p. 369.

Larat, Timor Laut. Type ♂, B. M.

The broader dark brown area on the primaries, with no subapical spot, the more chocolate borders, and more saffron tint of the secondaries below at once distinguish this from *H. pitys*.

14. *Huphina latilimbata*.

Belenois latilimbata, Butler, Ann. & Mag. Nat. Hist. ser. 4, vol. xviii. p. 247 (1876).

Port Moresby, New Guinea, and Darnley Island. Type, B. M.

Our series consists at present of sixteen examples.

15. *Huphina mentes*.

Pieris mentes, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 332 (1867).

Pieris synchrona, Röber, Tijd. Ent. xxxiv. p. 278; figured in xxxv. (1892).

Lombok. ♂, B. M.

Four examples are in the Hewitson collection.

16. *Huphina Smithii*.

Belenois pallida, Smith, Novit. Zool. i. p. 336 (1894).

Biak, New Guinea.

Allied to *H. latilimbata*. The name *Huphina pallida* is preoccupied.

17. *Huphina Dohertyana*.

Belenois Dohertyana, Smith, Novit. Zool. i. p. 337 (1894).

New Guinea.

18. *Huphina affinis*.

Pieris affinis, Vollenhoven, Mon. Pier. p. 40, pl. v. fig. 2 (1865).

Celebes. B. M.

19. *Huphina Boisduvaliana*.

Pieris Boisduvaliana, Felder, Wien. ent. Monatschr. vi. p. 287 (1862);

Reise der Nov., Lep. ii. p. 163, pl. xxiv. fig. 8 (1865).

Huphina Semperi and *ulbagona*, Semper, Reisen im Arch. Phil. v. pp. 237, 238, Taf. xxxvii. figs. 13-15, Taf. xxxviii. figs. 2, 3 (1890).

Wet form (= *H. balbagona*), ♂ ♂, ♀ ♀, Mindanao, Luzon. B. M.

• Intermediate form (= *H. Semperi*), ♂ ♂, ♀ ♀, Mindanao, Davao, Luzon. B. M.

Dry form (= *H. Boisduvaliana*), ♂ ♂, Mindoro, Manilla. B. M.

We now come to a subgroup which in colouring recalls the genus *Delias*, and on that account has mostly been confounded with that genus, although its neuration proves it to belong to *Huphina*.

20. *Huphina quadricolor*.

Pieris quadricolor, Salvin and Godman, P. Z. S. 1877, p. 148, pl. xxiii. figs. 3, 4.

New Ireland, New Britain, Duke-of-York Island, and New Pomerania. Nine examples, including type, B. M.

The correct position of this species alone was recognized; the others were referred to *Delias* by various writers.

21. *Huphina euryxanthe*.

Pieris euryxanthe, Hornath, Berl. ent. Zeitschr. xxvii. p. 435 (1892)
Oberthur, Etudes d'Ent. xix. p. 6, pl. ii. figs. 7 & 9 (1894).

Port Moresby. ♂, B. M.

It would not surprise me to discover that this was the dry phase of the following species.

22. *Huphina abnormis*.

♀. *Tachyris abnormis*, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 368,
pl. viii. fig. 5 (1867).

Seven specimens. ♂ ♂, Port Moresby, B. M. ♀ type,
coll. Hewitson.

23. *Huphina ladas*.

Delias ladas, Giese-Smith, Novit. Zool. i. p. 585 (1894); Rhop. Exot.
ii., *Del.* pl. v. figs. 4-6 (1895).

New Guinea.

Nearest to the following, but yellow at base of secondaries
on under surface.

24. *Huphina ornytion*.

Pieris ornytion, Godman and Salvin, P. Z. S. 1880, p. 613, pl. lvi.
fig. 5.

Seven examples. ♂ ♂, ♀ ♀, Port Moresby (including
type). B. M.

25. *Huphina Dohertyi*.

Pieris Dohertyi, Oberthur, Etudes d'Ent. xix. p. 61, pl. ii. fig. 2 (1894).

New Guinea.

I must confess that the fact of the last five species occurring
together in New Guinea, in conjunction with the fact that
similarly coloured species of the Nymphalid genus *Mynes*
occur there, is very suspicious. I cannot help thinking that
breeding experiments would tend greatly to reduce the
number of these "species" in both genera.

Group II.

26. *Huphina temena*.

Pieris temena, Hewitson, Exot. Butt. ii., *Pier.* pl. iii. fig. 19 (1861).

Lombok. ♂ ♂, ♀, B. M.

27. *Huphina tamar*.

Pieris tamar, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 337, pl. vi. fig. 2 (1867).

♀, Baly. Type, coll. Hewitson.

28. *Huphina julia*.

Huphina julia, Doherty, Journ. As. Soc. Beng. ix. 2, p. 187, pl. ii. fig. 12 (1891); Oberthür, Etudes, xix. pl. iii. figs. 11 & 17 (1894).

Sumba.

29. *Huphina læta*.

♂. *Pieris læta*, Hewitson, Exot. Butt. iii., *Pier.* pl. vii. figs. 45, 46 (1862); ♀. Vollenhoven, Mon. *Pier.* p. 31, pl. iv. fig. 3 (1865).

Timor. ♂♂, B. M. Type, coll. Hewitson.

30. *Huphina pactolica*.

♂. *Pieris pactolicus*, Butler, P. Z. S. 1865, p. 455, pl. xxvi fig. 1.

Seven examples, Borneo. Type, B. M.

31. *Huphina celebensis*.

Huphina celebensis, Rothschild, Deut. ent. Zeit., Lep. v. p. 439, pl. iv. figs. 1, 2 (1892).

Macassar, Celebes. Eight examples, B. M.

32. *Huphina eperia*.

Pieris eperia, Boisduval, Sp. Gén. Lép. i. p. 470 (1836).

Minahassa, Macassar, Celebes. Five examples, B. M.

In the Hewitson collection the female is regarded as that sex of *H. timnatha*.

33. *Huphina timnatha*.

♂. *Pieris timnatha*, Hewitson, Exot. Butt. iii., *Pier.* pl. vii. figs. 47, 48 (1862).

♀. *Pieris emma*, Vollenhoven, Mon. *Pier.* p. 24, pl. iv. fig. 2 (1865).
Pieris eurygonia?, Hopffer, Stett. ent. Zeit. 1874, p. 23.

Celebes and Batchian. Five examples, B. M.

Hopffer's type is said to have been obtained on the Togian Islands. It is described as having seven white submarginal spots on the primaries above and four on the secondaries; this is the case in some males of the present species.

34. *Huphina siamensis*, sp. n.

Nearly related to *H. lea*, larger; the males with considerably narrower black outer border to all the wings, the veins on the apical third of primaries much more narrowly black-bordered (not by any means subconfluent, as in *H. lea*); the orange patch on the secondaries much larger, but less vividly coloured: below, the black veins on the primaries are more slender and the yellow submarginal spots are much larger and more conspicuous, whilst the disk beyond the cell is of a clearer paler yellow; this is also the case in the female, which in other respects much more closely resembles that sex of *H. lea* than the males of the two species do.

Expanse of wings, ♂ 68 millim., ♀ 60 millim.

Siam, Chentaboon. ♂ ♂, ♀, B. M.

35. *Huphina lea*.

♂. *Pieris lea*, Doubleday, Ann. & Mag. Nat. Hist. xvii. p. 23 (1846).

Wet form, ♂ ♂, ♀ ♀, Moulmein, Rangoon, Perak, Singapore. B. M.

Intermediate form, ♂ ♂, various parts of Burma, Philippines. B. M.

Dry form, ♂ ♂, ♀, various parts of Burma and Pegu. B. M.

The type is our male from Moulmein incorrectly figured in Doubleday's 'Genera of Diurnal Lepidoptera' under the name of *Pieris clemathe*.

36. *Huphina hespera*, sp. n.

Above very like *H. lea*, but the female showing scarcely a trace of the tawny flush on the secondaries; below, all the dark markings are much broader and more confluent, the apical area of the primaries being deep vinous brown, enclosing two or three white dashes beyond the cell and an imperfect submarginal series. In the wet phase nearly half the secondaries is occupied by the dark brown outer border and most of the submarginal spots are obscured; the costal border of the primaries and the subcostal and median veins are much more heavily black-bordered than in the allied species. In the dry phase the border of the secondaries is reduced to half the width. Intermediate examples also occur in which this border is slightly wider than in the extreme dry types.

Expanse of wings, ♂ ♂ 60-70 millim., ♀ 58 millim.

Sarawak, Labuan, Singapore. B. M.

Our series consists of seventeen examples. The species has probably stood in collections as *clemanthe*, which is a *Prioneris*.

37. *Huphina naomi*.

Pieris naomi, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 336 (1867).

♂ ♂, ♀, Lombock. B. M. Types, coll. Hewitson.

Var. *Huphina eirene*.

Var. *Huphina eirene*, Doherty, Journ. As. Soc. Beng. lx. 2, p. 188 (1891).

"Sumba" (Doherty). ♂, Sambawa. B. M.

38. *Huphina Oberthuri*.

Pieris Oberthuri, Röber, Tijds. v. Ent. xxxiv. p. 277; figured in xxxv. (1892).

"Flores" (Röber). ♂, Laraut. B. M.

This is very close to the preceding species, but the submarginal spots on the under surface are much larger and more continuous, the apical spots on the primaries forming a tapering yellow patch; the secondaries are also more golden, with the subcostal vein and third median branch dusky.

39. *Huphina ethel*.

Huphina ethel, Doherty, Journ. As. Soc. Beng. lx. 2, p. 29 (1891).

Engano (Doherty).

Nearest to *H. judith*, but the border of the secondaries below extending to the cell, as in the wet phase of *H. hespera*.

40. *Huphina judith*.

Papilio judith, Fabricius, Mant. Ins. ii. p. 22 (1787); Donovan, Ins. Ind. pl. xxvii. fig. 2 (1800).

Papilio licea?, Fabricius, t. c. p. 20 (1787).

Thirteen examples, Java. B. M.

The type of *P. licea* not being in existence, that species can never be identified with certainty.

41. *Huphina selma*.

Pieris selma, Weymer, Stett. ent. Zeit. xlv. p. 269, pl. ii. fig. 5 (1885).

"Nias" (Weymer).

Differs from *H. judith* in its much narrower border to

secondaries; if both insects occurred in the same island, they would undoubtedly represent wet and dry phases of the same species, but there is no evidence at present that either insect varies seasonally.

42. *Huphina aspasia*.

Pupilio aspasia, Stoll, Suppl. Cramer, pl. xxxiii. figs. 3, 3c (1790).

Pieris asterope, Godart, Enc. Méth. ix. p. 154 (1819).

Pieris jael, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 335 (1867).

Amboina, Ceram, Bouru, Sulu Archipelago. B. M.

H. jael from Bouru appears to have yellower secondaries than typical *H. aspasia*, but our examples of the latter are old and perhaps have deepened with age—a very common occurrence among the *Pierinæ*.

43. *Huphina olga*.

Pontia olga, Eschscholtz, in Kotzeb. Reise, iii. p. 214, pl. ix. figs. 21 a, b (1821).

Huphina imogene, Doherty, Journ. Asiat. Soc. Beng. lx. p. 188 (1892).

Batchian, Philippines, Hong-Kong. B. M.

The wet form, of which we have fourteen examples, attains a greater size, is more heavily adorned with black veins and borders, and is deeper in colouring than the dry form, of which we have eighteen examples. *H. imogene* (figured by Hombron and Jacquinot as *H. judith*) belongs to the dry phase. *H. olga* differs from *H. aspasia* in the broader borders to the secondaries.

44. *Huphina olgina*.

Pieris aspasia, var. *olgina*, Staudinger, Deut. ent. Zeit., Lep. 1889, p. 19.

Palawan. ♂♂, ♀, B. M.

Differs from *H. olga* in the clear butter-yellow of the subapical spots of the primaries and of the secondaries on the under surface. The female which we possess differs greatly, the upper surface being chiefly ashy grey, with the usual pale patches quite white.

45. *Huphina hester*.

♀. *Pieris hester*, Vollenhoven, Mon. Pier. p. 24, pl. iv. fig. 1 (1865).

Mysol and Waigiou. ♂, ♀, coll. Hewitson.

Allied to *H. olga*.

The following species, though possessing the pattern of the

preceding forms, more nearly resemble *Ganoris napi* and allies in coloration.

46. *Huphina phryne*.

Papilio phryne, Fabricius, Syst. Ent. p. 473 (1775).

Papilio evagete, Cramer, Pap. Exot. iii. pl. ccxvi. F, G (1782).

Papilio zeuxippe, Cramer, l. c. iv. pl. cccxii. E, F (1782).

Papilio cassida, Fabricius, Ent. Syst., Suppl. p. 427 (1798).

Huphina pallida, Swinhoe, P. Z. S. 1885, p. 137.

India, Ceylon, and Java. B. M.

Of this species we have retained a selected series of seventy-one examples, exhibiting a range over the greater part of India. The wettest phase is *H. phryne*, of which *H. zeuxippe* is a slightly less strongly marked form; the two grade into one another, so that they can only be arbitrarily separated. The intermediate phase—*H. cassida*—is still less strongly marked, and varies from brimstone to sandy buff on the under surface of the secondaries. The extreme dry phase is *H. pallida*, in which the secondaries are uniform yellowish buff in the male, a trifle more sandy and with traces of dusky veins in the female. We thus have a perfect transition from the wettest to the driest form—from secondaries bright chrome-yellow with broad blackish veins and a discal belt of almost continuous blackish spots to those which are uniform yellowish buff. Those who oppose the publication of the ascertained facts relating to seasonal variation attempt to distinguish these gradations as different species, though in many cases it is quite fortuitous whether certain specimens shall be placed under one or the other name.

47. *Huphina hira*.

Pieris hira, Moore, P. Z. S. 1865, p. 490, pl. xxxi. fig. 17.

Pieris copia, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 340 (1867).

Appius dapha, Moore, P. Z. S. 1878, p. 838.

Burma, Tenasserim. B. M.

We have retained twenty-seven examples. *H. copia* is the wet phase and *H. hira*=*dapha* the dry; the apical border of the primaries varies, being sometimes streaked with grey or whitish, but often uniformly black.

48. *Huphina vaso*.

Huphina vaso, Doherty, Journ. As. Soc. Beng. lx. 2, p. 188 (1891);

Oberthür, Études, xix. pl. iii. fig. 18 (1894).

Sambawa.

This is a dry-season phase, differing chiefly from that of the succeeding species in the more open veined borders to the wings.

49. *Huphina corva*.

Pieris corva, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 339 (1867).

Java, Bali, Sumatra. B. M.

The dry phase is usually slightly smaller than the wet and the ground-colour of the secondaries below is sandy buff instead of creamy white; the discal series of spots is also reduced in size.

50. *Huphina dissimilis*.

Huphina dissimilis, Rothschild, Deut. ent. Zeit., Lep. v. p. 440, pl. v. figs. 5, 6 (1892).

Celebes.

Very like the dry phase of *H. corva*.

51. *Huphina lichenosa*.

Pieris lichenosa, Moore, P. Z. S. 1877, p. 591.

Andamans. B. M.

52. *Huphina sumatrana*, sp. n.

An insular representative of *H. nerissa*; the male of the wet phase differs in its slightly inferior size, the absence of the blackish bar connecting veins 1 and 2 on the primaries; on the under surface the apical area of the primaries and ground-colour of the secondaries saffron instead of primrose-yellow, the veins gravel-brown excepting the median vein of the primaries and the borders of the veins below it, which are dark brown inclining to black.

Expanse of wings 61 millim.

♂, Sumatra (from G. & S. coll.). B. M.

53. *Huphina nerissa*.

♂. *Papilio nerissa*, Fabricius, Syst. Ent. p. 471 (1775).

♂. *Papilio amasene*, Cramer, Pap. Exot. i. pl. xlv. A (1776).

♀. *Papilio coronis*, Cramer, t. c. B, C (1776).

Nepal, Darjeeling, Tonkin, China. B. M.

We have twenty-five selected examples of this species. The dry phase has the under surface of the secondaries pale creamy buff, with sandy-greyish veins and spots.

The following subgroup contains species in which the sexes differ somewhat in the manner of *Phrissura ægis* in their upper-surface pattern, but on the under surface they show a good deal of olive-green colouring in their wet and intermediate phases. I know of no other Pierinæ which at all closely resemble them.

54. *Huphina nadina*.

♂. *Pieris nadina*, Lucas, Rev. et Mag. de Zool. 1852, p. 333.

♀. *Pieris nama*, Moore, Cat. Lep. E. I. C. i. p. 76 (1857); P. Z. S. 1857, p. 102, pl. xlv. figs. 1, 2.

♂. *Pieris amba*, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 340 (1867).

Appias amboides, Moore, Journ. As. Soc. Bang. liii. p. 46 (1884).

Darjeeling, Silhet, Assam, Manipur, Pegu, Tenasserim, Burma. Seventeen examples, B. M.

H. nadina was described from a male of the wet phase and a female of *Appias zelmira*, *H. nama* from a male of the intermediate and a female of the wet phase, *H. amba* and *amboides* from males of the dry phase. *H. amboides* differs from *H. amba* in the absence of the sandy-brown discal band on the under surface of the secondaries; as it occurs in the same localities as the typical phases of the species, it is not likely to be more than an extreme development of the dry form.

55. *Huphina Andersoni*.

Appias Andersoni, Distant, Ent. xviii. p. 146 (1895); Rhop. Mal. pl. xxxiii. fig. 2.

Perak.

Allied to the preceding species, but the apex of the primaries and the secondaries below rich golden yellowish.

56. *Huphina andamana*.

Huphina nama, var. *andamana*, Swinhoe, P. Z. S. 1889, p. 398.

Andamans. Twelve examples, B. M.

The intermediate phase differs from the wet in the much browner coloration of the apex of the primaries and the secondaries below, the spot in the centre of the latter wings white instead of canary-yellow; in the dry phase there is scarcely any yellow left upon the under surface and the apex of primaries and secondaries are paler and greyer; the outer border of the primaries above is also slightly narrower.

57. *Huphina Fawcetti*, sp. n.

Represents the preceding species in Sumatra: the wet
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phase is darker olivaceous below, with a smaller and white spot crossed by vein 5; the intermediate phase does not, however, differ in the same way from the corresponding phase of *H. andamana*, so that I am not certain of the constancy of this difference. On the upper surface the outer border extends further on to the costal margin of the primaries than in *H. andamana* and is considerably broader, black, and sharply defined from veins 3 to 7 on the secondaries.

Sumatra (*Fawcett and Sachs*). Two males, B. M.

58. *Huphina remba*.

Pieris remba, Moore, Cat. Lep. E. I. C. i. p. 75 (1857).

Huphina liquida, Swinhoe, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 361 (1890).

Mussourie, Mahableshwar, Mysore, Canara, Ceylon. B. M.

H. liquida is a male of the wet phase; the type is a male of the intermediate phase, rather browner below than Col. Swinhoe's type; and "*H. liquida* ♀" is a male of the dry phase, in which the apex of the primaries and the secondaries become sandy greyish.

The preceding species lead on naturally to *Udaina cynis*, in which the wet phase (*U. Pryeri*, Dist.) has the basal area of the secondaries and a slender bar crossing the cell on the under surface olivaceous. Although hitherto we have not received this phase from Malacca, we have the intermediate phase, in which the basal area of the secondaries is grey below, from Malacca, and we have the extreme dry phase (*U. cynis*) in the Hewitson collection from Borneo. I therefore have not the least doubt of the specific identity of the two forms. It is possible, as I have already suggested, that this species may be the true *Papilio monuste* of Linnæus; but, as the type is lost, this point can never be definitely settled.

XXXIII.—List of Fishes collected during the Peary Auxiliary Expedition, 1894. By OTTO HOLMQVIST, of the Zoological Institute, Lund, Sweden.

THE Peary Auxiliary Expedition offered but few opportunities for collecting sea-animals. Dr. A. Ohlin, the zoologist of the expedition, mentions* only seven trawling-stations,

* "Zoological Observations during the Peary Auxiliary Expedition,

situated for the most part in Inglefield Gulf or in the neighbourhood of that bay, between 77° and 78° N. lat. Fishes were obtained in a comparatively great number of both species and individuals in no less than four of these localities.

The following table shows the conformation of the localities in question, the distribution of species, and the date of capture:—

Murchison's Sound.—Depth 45 fathoms; bottom rocky and muddy.
July 29.

	Specimens.
<i>Icelus hamatus</i>	38
<i>Eumicrotremus spinosus</i>	1
<i>Gymnelis viridis</i>	1
<i>Lycodes Lütkenii</i>	1
<i>Gadus saida</i>	1
Five species	42

Inglefield Gulf.—Depth 25 fathoms; bottom rocky and muddy.
August 3.

	Specimens.
<i>Phobctor ventralis</i>	3
<i>Icelus hamatus</i>	61
<i>Centridermichthys uncinatus</i>	6
<i>Triglops Pingelii</i>	1
<i>Eumicrotremus spinosus</i>	20
<i>Gymnelis viridis</i>	7
<i>Lycodes Lütkenii</i>	1
Seven species	99

Neighbourhood of Cape Faraday.—Depth 5 fathoms; bottom sandy.
August 7.

<i>Liparis lineatus</i>	13
<i>Gadus saida</i>	1
Two species	14

Neighbourhood of Northumberland Island.—Depth 20 fathoms;
bottom rocky. August 13.

	Specimens.
<i>Triglops Pingelii</i>	1
<i>Icelus hamatus</i>	2
Two species	3

To this list may be added two small fishes, the state of preservation of which, however, renders them indeterminable: one was captured with the surface-net in Inglefield Gulf, the other was obtained in the trawl off Northumberland Island. Both seem to belong to the same species, but are certainly different from any other species collected during the expedition.

As shown by this list, the locality marked Inglefield Gulf has been, beyond all other places, the most fruitful in results. Not less than seven species, represented by ninety-nine individuals, were obtained at this station. This circumstance may depend partly on the fact that this locality has been trawled twice, while at each of the other stations but one dredging was performed (as communicated to me by Dr. Ohlin).

The station of Murchison's Sound was situated "just where a river from a recedent glacier was flowing out into the sea, the water being here, to a considerable distance from the shore, very brackish"*. The occurrence in this place of purely marine forms, such as *Eumicrotremus spinosus* and *Lycodes Lütkenii*, shows, however, that the water was of a normal saltness at the bottom.

The material obtained by the dredge necessarily affords a very imperfect idea of the fish-fauna, the trawl-net hardly being able to catch other than slow-swimming bottom-species. Apart from this circumstance, the fish-material of the expedition may be considered very satisfactory, as is clearly shown in comparison with former arctic expeditions. The 'Dijmphna-Togt' was among the most fruitful in results. This expedition achieved not less than 190 dredgings in various parts of the Kara Sea, amongst which only 28 trawlings produced 170 specimens; these represented 11 species. Nares's expedition executed a great number of trawlings off North-western Greenland on a wide area between 78° and 83° N. lat., but obtained only 23 marine fishes, belonging to 7 species. During the Peary Auxiliary Expedition but a few limited dredgings were effected; yet no less than 9 (10) species of fishes were obtained, represented by 158 (160) specimens: besides which a number of Cottid fishes were thrown away through lack of preservative material, as I am informed by Dr. Ohlin. Comparatively speaking, this result is much greater than that of the 'Dijmphna' Expedition—nay, in proportion to the number of trawlings it probably is the most considerable product that any previous arctic expedition has afforded.

* Ohlin, *l. c.* p. 171.

Besides the purely marine species above mentioned, 13 specimens of *Gasterosteus aculeatus* were caught on the beach at Godhavn; including these, the total number of fishes obtained by the Expedition amounts to 171 (173) specimens, distributed among 10 (11) species.

Phobetor ventralis, Cuv. & Valenc.

Cottus ventralis, Cuvier & Valenciennes, Hist. nat. des Poissons, t. iv. p. 194.

Phobetor tricuspis, H. Krøyer, Naturhist. Tidsskrift. 2den Række, 1ste Bind, p. 203.

Acanthocottus patris, H. R. Storer, "Observations on the Fishes of Nova Scotia and Labrador," &c., Boston Journal of Natural History, vol. vi. p. 250, pl. vii. fig. 2.

Gymnanthus pistilliger, R. Collett, The Norwegian North-Atlantic Expedition, 1876-78, Zoology, Fishes, p. 26.

This species is represented by three specimens (one male and two females) from Inglefield Gulf, which is, so far as I know, the point furthest north on the coast of Greenland where this species has been observed. Nares's Expedition (see above) did not obtain any specimens. According to Collett and Malmgren it is still common in the Atlantic Ocean around Northern Spitzbergen. Amongst the specimens obtained during the Expedition the largest measures 108 millim. in length. One specimen has 12 rays in the first dorsal fin, the usual number being 10 or 11.

Icelus hamatus, Krøyer.

Icelus hamatus, H. Krøyer, *tom. cit.* p. 253; A. Günther, "Account of the Fishes collected by Capt. Feilden between 78° and 83° N. lat. during the Arctic Expedition, 1875-76," Proc. Zool. Soc. London, 1877, p. 293; R. Collett, *loc. cit.* p. 34, pl. i. fig. 8; Chr. Luthen, *Dijmphna-Togtets zoologisk-botaniske Udbytte*, p. 123 (1887).

Dr. Ohlin's collection contains no less than 101 specimens of this species, which is, perhaps, the most common and widely distributed among the arctic Cottids. The greatest number (61) are from Inglefield Gulf; of the remainder, 38 specimens were caught in Murchison's Sound and 2 in the neighbourhood of Northumberland Island. The largest specimen (a female 95 millim. in length) is from Inglefield Gulf; the smallest is 30 millim. long and from the same locality. Between these two all sizes are well represented.

The proportion of males to females is as 7 to 10.

Concerning the extension of the lateral line, Collett* says that it is often absent posteriorly, "which cannot be

* *L. c.*

accounted for by the immaturity of the individual." Lütken, in the '*Dijmphna-Togt*,' makes nearly the same statement, but with the modification that the lateral line ends in very young individuals exactly above or in front of the anal fin; in other cases variation in the extension of the lateral line may be due to difference in locality.

An examination of the numerous specimens obtained during the Peary Expedition plainly indicates that the extension of the lateral line stands in an almost constant ratio to the age of the fish without regard to locality. In the smallest individuals—about 30 millim. in length—it is reduced to a few slight tubercles just in front of the anus; the lateral line is extended more backward, with very little variation, in proportion to the size of the fish, reaching to the caudal in all tolerably grown individuals. Excepting in very young individuals, the spines of the lateral line are nearly always stronger than those of the dorsal line. The lateral line begins with fully developed spines close to the upper corner of the gill-opening. The tubercles of the dorsal line appear some distance behind the commencement of the lateral line as small points that increase in size backward, and eventually become transformed into ordinary thorny spines.

Only one specimen (a small female from Inglefield Gulf) has a slight and thin row of tubercles on each side at the base of the anal; the other specimens show no trace of such an appendage. Neither has Lütken seen these spines in any of the sixty-six specimens of the '*Dijmphna-Togt*.' Their occurrence may be considered exceptional, or, perhaps, restricted to certain localities, especially, according to Collett*, the Scandinavian coasts†.

Most of the specimens in this collection possess a row of tubercles behind the pectorals. In the specimens where this row is most strongly developed it runs into the lateral line close to the points of the pectorals.

* *L. c.* p. 36.

† The only Scandinavian specimen I had an opportunity of seeing is very young, and was dredged (July 1895) by Dr. Carl Aurivillius from a depth of 40-70 fathoms in Koster Bay (Northern Bohuslän). Its total length is 17 millim. No spines in the lateral line or behind the pectorals. The spines of the dorsal line are well developed and reach to the caudal; they originate on the skull, being throughout long and sharp. The foremost pair of parietal tubercles slightly marked. The upper præopercular spine simple and bent upwards. No spines along the base of the anal.

Centridermichthys uncinatus, Reinhardt.

Cottus uncinatus, T. Reinhardt, sen., Kongl. Danske Vidensk. Selsk., Naturvid. og Mathem. Afhandl. Deel 6, p. xlix.

Centridermichthys uncinatus, R. Collett, Norges Fiske, p. 31; id. The Norwegian North-Atlantic Expedition, Zoology, Fishes, p. 29, pl. i. fig. 7; Chr. Lütken, Dijnphna-Togtets zoologisk-botaniske Udbytte, p. 124.

This species is represented by six small specimens from Inglefield Gulf; the largest measures 61 millim. in length and the smallest 31 millim.

Concerning its geographical distribution, Collett* states that the species exists in a relatively southern region. In the Arctic Ocean of Europe it is not caught further to the north than in station 326 of the Norwegian North-Atlantic Expedition at 75° 31' N. lat., and Nares's Expedition did not obtain any specimen between 78° and 83° N. lat. The comparatively numerous occurrence of this species in Inglefield Gulf, between 77° and 78°, proves that it is more distributed northwards than has hitherto been supposed, although it perhaps ought to be looked for in those latitudes chiefly at a lesser depth.

Triglops Pingelii, Reinhardt.

Triglops Pingelii, T. Reinhardt, sen., loc. cit. 7de Deel, pp. 114 & 118; A. Günther, "Account of the Fishes collected during the Arctic Expedition, 1875-76," Proc. Zool. Soc. London, 1877, p. 476; R. Collett, The Norwegian North-Atlantic Expedition, 1876-78, Zoology, Fishes, p. 38, pl. i. figs. 9-10.

Only two specimens were collected during the Expedition; both are females and are not well preserved.

Northumberland Island and Ingleneld Gulf.

Gasterosteus aculeatus, Linné.

Gasterosteus aculeatus, f. *hemigymnus*, R. Collett, Norges Fiske, p. 11; id. "Meddelelser om Norges Fiske i Aarene 1875-78," Christiania Vidensk. Selsk. Forhandling, 1879, no. 1, p. 1.

Thirteen small specimens were caught in "Fjären" (that part of the shore laid bare by ebb) at Godhavn; their size does not exceed 3 centim. Most of them belong to Collett's variety *hemigymnus*†, distinguished by the absence of osseous plates on the tail and on the greater part of the sides of the body, as well as by the presence of ridges on both sides

* The North-Atlantic Expedition, part iii. p. 33.

† Norges Fiske, p. 12.

of the tail. So far as I know, this form has not hitherto been noticed from Greenland.

One specimen represents Cuvier's var. *semiloricatus*.

Liparis lineatus (Lepechin).

Liparis barbatus, C. U. Ekström, Kongl. Vet.-Akad. Handl. för år 1832, p. 168, tab. v. (Stockholm).

Liparis tunicatus, T. Reinhardt, sen., Oversigt over Kongl. Danske Vidensk. Selsk. Forh. den physiske Classe, fra den 31 Maj 1832 til d. 31 Maj 1836, sid cxi.

Liparis arctica, Th. Gill, "Synopsis of the Cyclopteroids of Eastern North America," Proc. Acad. Nat. Sci. Philad. 1864, p. 191.

Liparis lineatus, R. Collett, The Norwegian North-Atlantic Expedition, 1876-78, Zoology, Fishes, p. 50.

Thirteen specimens of this *Liparis* were collected off Cape Faraday. The largest measures 100 millim. in length and much resembles Collett's variety *arcticus* *. This form is of a nearly uniform greyish-brown colour, but with the ventral side somewhat lighter, and probably represents Gill's *Liparis arctica* according to Collett †. All the other specimens are considerably smaller—40 to 60 millim. long—and most nearly resemble the varieties *stellatus*, Malm, and *subfuscus*, Collett ‡, though not altogether agreeing with either.

Eumicrotremus spinosus, Fabricius.

Cyclopterus spinosus, O. Fabricius, in O. F. Müller's Zoologiæ Danicæ Prodrömus, p. ix.

Eumicrotremus spinosus, Th. Gill, *tom. cit.* 1864, p. 190.

Cyclopterus spinosus, A. Günther, *tom. cit.* part ii. pp. 293 & 476.

Eumicrotremus spinosus, R. Collett, *loc. cit.* p. 47, pl. ii. fig. 13.

Twenty small specimens were obtained in Inglefield Gulf and one in Murchison's Sound. The largest is among the former and measures 45 millim. in length. Most of them are young, and the smallest is only 17 millim. long; the latter specimen and a few others not much longer are devoid of scales and without distinct rays in the first dorsal. Collett § supposes this species to be a deep-sea fish, as it has not hitherto been obtained at a less depth than 60 fathoms; but this supposition is contradicted by its abundant occurrence in Inglefield Gulf at a depth of only 25 fathoms and at the mouth of a glacial river.

* "Om Norges Fiske i Aarene 1875-78," Christiania Vidensk. Selsk. Forhandl. 1879, no. 1, p. 44.

† 'The Norwegian North-Atlantic Expedition,' p. 50.

‡ "Om Norges Fiske," &c. p. 42.

§ L. c. p. 49.

Gadus saida (Lepechin).*Gadus Fabricii*, A. Günther, *tom. cit.* part ii. pp. 294 & 476.*Gadus saida*, Chr. Lütken, *Dijmphna-Togtet*, p. 127.

A small specimen was caught off Cape Faraday, and a young *Gadus* obtained in Murchison's Sound belongs, in all probability, to the same species, though, owing to its being in a mutilated condition, it has not been possible to determine this with certainty.

Gymnelis viridis (Fabricius).

Gymnelis viridis, A. Günther, *tom. cit.* part ii. p. 294; R. Collett, *The Norwegian North-Atlantic Expedition, 1876-78, Zoology, Fishes*; Chr. Lütken, *Dijmphna-Togtets zoologisk-botaniske Udbytte*.

One specimen was collected in Murchison's Sound, and seven were caught in Inglefield Gulf; the largest was obtained in the latter locality and measures 123 millim. in length. The principal colour of this specimen when preserved in alcohol is grey; the sides of the body are marked along their whole length by regularly arranged patches, almost square and lightly marbled. Four individuals are of a nearly uniform grey; three others have a number of whitish circular spots, closely placed and generally distinctly limited. As is well known, the variability of this species is very great. With regard to the colour, Krøyer has* recorded not less than thirty-three varieties, and several others might be added.

Lycodes Lütkenii, Collett.

Lycodes reticulatus, Collett (nec Reinh.), *Forhandl. i. Vidensk. Selsk. i Christiania, 1878, no. 14, p. 59.*

Lycodes Lütkenii, Collett, *The Norwegian North-Atlantic Expedition, 1876-78, Zoology, Fishes, p. 103, pl. iii. fig. 25*; Chr. Lütken, *Dijmphna-Togtets zoologisk-botaniske Udbytte, p. 128, pl. xvi. figs. 1-6.*

A young *Lycodes* was obtained in Murchison's Sound; another somewhat larger specimen was captured in Inglefield Gulf.

With regard to the immature Lycodids, our knowledge is still very imperfect, especially as to their systematic relations. It might therefore appear rather premature to identify the specimens in question with *Lycodes Lütkenii*, Collett, the more so as this cannot with absolute certainty be considered a species distinct from *L. reticulatus*, Reinh. As to the proportions of the head and the pectorals, as well as their colour,

* Naturhist. Tidsskrift 3dje Række, 1ste Bind (Copenhagen).

however, both specimens closely correspond with some young Lycodids from the Kara Sea that Lütken has * identified with *L. Lütkenii*. Thus it seems safe to consider them to belong to the same species.

Below are some measurements &c. of my specimens :—

	Specimen from Murchison's Sound.	Specimen from Inglefield Gulf.
Number of rays in the pectoral.	18	18
Width of the pectoral	equals the height of the body + the dorsal.	equals the height of the body + the dorsal.
Length of the pectoral	6 mm.	8 mm.
Length of the tail †..	24 mm.	36 mm.
Height of the head	equals the greatest height of the body ‡.	a little less than the greatest height of the body ‡.
Length of the head ..	10.5 mm.	14 mm.
Total length	44 mm.	56 mm.

As will appear by this list, the length of the head is about one fourth of the total length, and the length of the pectorals is about one seventh of the total length; in both specimens the tail was a little more than half of the total length.

Lütken mentions the length of the head in the specimens from the Kara Sea as about one fourth, and that of the pectorals little less than one seventh, of the total length. The tail, measured from the anus to the end of the caudal, is in the same individuals very little more than half the length of the body, although with a slight variation. According to Lütken, the proportion of the tail affords a characteristic difference between *L. Lütkenii* and *L. reticulatus*, Reinh. In Collett's type specimens, however, the tail is comparatively longer than in the specimens from the Kara Sea, at least if we judge by the figures. In the *Lycodes* from Inglefield Gulf the tail is a little longer than it is depicted in Collett's figures; but, considering the usual variability of the tail in long-tailed fishes, the peculiarity just referred to cannot prevent us from identifying that specimen also with *L. Lütkenii*. For the same reason the length of the tail cannot be considered a valid characteristic. The exceptional size of the pectorals, which in more mature specimens are broader than the body is high, is, without doubt, the safest criterion (Collett's type

* *L. c.*

† Measured from the anus to the point of the caudal.

‡ Without the dorsal.

specimens). In Collett's specimens the pectorals have 23 rays; in Lütken's they have 16-18, in rare cases 19 rays. The variation is accounted for by Lütken as dependent on difference of age. As I have already stated, my specimens have 18 rays, although they are very young. In both specimens the width of the head is greater than that of the body and equal to the length of the pectorals. The eyes are situated much nearer the snout than the neck. The ventrals lie exactly on the line that is supposed to connect the gill-openings at their base. Both individuals are devoid of scales. The mucous membrane of the mouth is white.

The smaller specimen (from Murchison's Sound) is nearly identical with Lütken's fig. 5 in the '*Dijmphna-Togt*' with regard to both shape and colour. In both specimens the sides of the body and the dorsal are marked with irregular square spots with blackish margins. These spots are smaller and more numerous in the smaller specimen, which is much paler both in prevailing colour and marks.

Lund, Sweden,
May 1895.

XXXIV.—*Note on the Water-Voles of Bosnia, Asia Minor, and Western Persia.* By G. E. H. BARRETT-HAMILTON .....	223

IN looking over the specimens of Water-Voles preserved in the British Museum collection I find examples of two forms from Bosnia and Asia Minor which I am unable to associate with any of the known subspecies found in Western Europe, and one of which at least seems to me to have been hitherto undescribed.

The Water-Voles of Western Europe, as is well known, have been the subject of a good deal of species-making, and our knowledge of the synonymy and relations of the various local races or subspecies is at present in a rather confused condition. My friend Mr. Gerrit S. Miller, Junior, Assistant Curator of Mammals at Washington, whose masterly paper "*On the Genera and Subgenera of Voles and Lemmings*"* has already cleared away so many difficulties, has, in addition, imposed upon himself the task of unravelling the tangle which surrounds the subgenus *Arvicola*, Lacépède, to which the Water-Voles belong. As I do not wish to anticipate anything

* U.S. Department Agriculture (Div. of Orn. & Mamm.): North-American Fauna, no. 12 (July 23, 1896).

which he may have to say, I merely give a description of the subspecies, leaving their relationships to be more exactly determined by Mr. Miller.

The specimens from Van, Asia Minor, were presented to the British Museum by Major W. H. Williams, R.A. They formed part of a valuable collection of mammals which has yielded two new species in *Ellobius lutescens* and *Alactaga Williamsi*, both of which were described by Mr. Oldfield Thomas in the 'Annals' for Sept. 1897, ser. 6, vol. xx. pp. 308-310. They belong to a large form allied to *M. Musignani*, de Selys, of South Europe, but readily distinguishable by the greater thickness of the fur, the colour of which on the upperside is yellowish brown rather plentifully sprinkled with black-tipped hairs, especially on the dorsal line and upper surface of the head. The upperside of the animal has thus a very peculiar grizzled appearance, which I have not observed in any other subspecies. The underside is whiter than in any other Water-Vole with which I am acquainted, Scandinavian, British, and Spanish specimens being very rufous underneath. Of the two males at my disposal, the larger and adult has the underside quite white, contrasting by a clearly marked line of demarcation with the yellowish-brown colour of the flanks; the smaller and younger specimen has the central portion of the belly slightly washed with yellow. In both the white colour is continued in a modified and less pure form to the upper lips, and also extends higher up on each side of the neck than in other Water-Voles. The tail is slightly bi-coloured.

The dimensions are given below. I find no distinctive characters in the skull; the nasals are distinctly compressed posteriorly, but I am not sure if that character will hold good for a series of specimens.

It seems best to identify the Kurdistan Voles (at least provisionally) with the form which de Filippi found very commonly in Western Persia and to which he gave the name of *persicus* (Viag. Persia, 1865). His description is not at all full, and consists mainly in the statement (on page 196) that *M. persicus* is markedly lighter on the underside than are the Water-Voles of Europe and (on page 344) that it may be distinguished from the ordinary race of Europe "per il colore che passa al fulvo sui fianchi, ed al bianco nelle parti inferiori. I caratteri osteologici sono assolutamente i medesimi." Yet since, so far as it goes, this description agrees with the specimens collected by Major Williams, I prefer to

make use of de Filippi's name rather than to add another to a genus already overburdened.

The British Museum possesses the skull of a Water-Vole from the Altai Mountains, which, in the absence of a skin, I am obliged to associate provisionally with this subspecies.

For the Water-Vole of Bosnia I propose the name

Microtus Musignani illyricus, subsp. n.

A large Water-Vole intermediate between the subspecies *M. persicus*, de Fil., and *M. Musignani*, de Selys, of Spain, and in that the upperside lacks the almost rufous-brown tint of the ordinary Spanish specimens and is grizzly yellowish brown, not, however, so marked as in *M. persicus*. The thickness of the coat also agrees with that of Spanish specimens, and not with that of *M. persicus*. The dirty white colour of the under-side is indistinctly marked off from the yellowish-brown flanks, is not washed with yellow, and does not extend to the upper lips or high up on the sides of the neck.

The type (no. 94. 1. 5. 1 of the British Museum collection) is from Bosnia, and was collected by Dr. Floericke. I believe it represents a subspecies occurring in the Turkish peninsula and which is intermediate between *M. Musignani* of Spain and Italy and *M. persicus* of Asia Minor.

The following are the dimensions of the specimens in millimetres :—

	Head and body.	Tail.	Hind foot.	Ear.	Greatest length of skull.
<i>M. persicus</i> . Brit. Mus. Coll. no. 97. 6. 4. 10. Adult male from Van, Asia Minor (dug out of a hole by a stream, Dec. 23, 1897)	195	126	29	18	42
<i>M. persicus</i> . Brit. Mus. Coll. no. 97. 6. 4. 9. Young male from Van, Asia Minor (dug out of a hole by a stream, Dec. 13, 1897)	153	104	31	16	38
<i>M. illyricus</i> . Brit. Mus. Coll. no. 94. 1. 5. 1. Bosnia. (Measured in dried skin.) ..	190	100	30	..	about 40 (damaged)

XXXV.—*Note on the Sicilian Dormice of the Genera Eliomys and Glis.* By G. E. H. BARRETT-HAMILTON.

I HAVE recently had the pleasure of examining a small collection of Sicilian mammals presented to the British Museum by Mr. J. I. S. Whitaker. The collection includes specimens of *Pachyura etrusca* (Savi), *Mus rattus alexandrinus*, Is. Geoff., *Mus musculus spicilegus*, Chyzer, a *Muscardinus*, and of *Microtus subterraneus nebrodensis*, Minà-Palumbo, the latter subspecies very doubtfully distinct from the form found on the Italian mainland.

In the present paper, however, I wish to call attention to the Sicilian *Eliomys* and *Glis*, which are of great interest and show marked differences from the corresponding forms found in Continental Europe.

The following is a description of the *Eliomys* :—

Eliomys pallidus, sp. n.

Size similar to that of *E. quercinus* (Linn.), but general appearance markedly different, the upper surface being light powdery-looking grey, with only a faint trace of the rich rufous brown of *E. quercinus* on the back. The black markings of *E. quercinus* are in *E. pallidus* everywhere less intense and distinct, and, as a natural consequence of the general coloration, the grey of the upper merges with the white of the under surface rather gradually, and the very clear line of demarcation of, as well as the intermediate black zone sometimes present in, *E. quercinus* is absent.

The following are the dimensions (in millim.) of two specimens, together with those of two of *E. quercinus* for comparison :—

	Head and body.	Tail.	Hind foot.	Ear.
<i>E. pallidus</i> (type). Brit. Mus. Coll. no. 98. 10. 6. 6. ♂, Sicily, August 21, 1898 . . .	147	108	20	24
<i>E. pallidus</i> . Brit. Mus. Coll. no. 98. 10. 6. 7. ♀, Sicily, August 18, 1898	124	106	28	23
<i>E. quercinus</i> . Brit. Mus. Coll. no. 95. 4. 6. 1. Spalato, Dal- matia, Jan. 26, 1895	145	105	25	..
<i>E. quercinus</i> . ♂, Seville, Spain, May 13, 1895 (the late Lord Lilford)	150	98	26	..

I regret that I am unable to give any cranial dimensions for *E. pallidus*; the length of the upper molar crowns of a series of *E. quercinus* from Dalmatia and Seville is from 6 to 6.50 millim.

The type of *E. pallidus* is no. 98. 10. 6. 6 of the British Museum Collection.

Of *E. quercinus* the British Museum possesses specimens from France, Mürren (Switzerland), Bavaria, Thüringen (Tyrol, Austria), Dalmatia, North-west and South Spain, and Portugal; but a specimen from Tunis appears to be referable to *E. melanurus*, Wagner.

Specimens from Tangier, Morocco, agree in size with *E. mumbyanus* (Pomel), first described from Algeria, and I therefore provisionally refer them to that species, although the skins at present at my disposal are too old and faded to enable me to gain a clear idea of their original colour. This would appear, however, to be a slightly paler animal than *E. quercinus*, although not nearly so pale as *E. pallidus*. The difference in size between the two species will be appreciated by a glance at the series of cranial measurements (in millim.) given below. The skull of *E. quercinus* is very much larger than that of *E. mumbyanus*, and, in addition, the brain-case is flatter, the nasal region broader and more solid, and the nasals themselves more compressed posteriorly.

E. mumbyanus *.

	Length of upper molar crowns.	Length of lower molar crowns.	Greatest length of skull. (Damaged.)	Length of nasals (along central line).
Algiers, 1856	5	5		10
B. M. Coll. no. 55.12.24.367. (Morocco.)	5	5	"	10
B. M. Coll. no. 48.2.16.3. (Tangier.)	5	5	33	10

E. quercinus.

B. M. Coll. no. 95. 3. 3. 41. (Seville.)	6	6	41.50	16
B. M. Coll. no. 95. 3. 3. 19. (Seville.)	6	6	40.25	15.50

The only external measurements of *E. mumbyanus* which I am able to give are (in millim.) :—

	Head and body.	Tail.	Hind foot.	Ear.
B. M. Coll. no. 98. 2. 16. 3 (in alcohol)	100	(Damaged.)	21	17
A dried skin from Tangier	109	79	23	16

* There is also in the British Museum Collection a skull (no. 94. 3. 12. 2) of *E. mumbyanus* presented by Dr. V. L. Seoane and labelled as from Cabañas, North-west Spain, but I fear there must be some mistake about this locality.

The following is the description of the Sicilian *Glis* :—

Glis insularis, sp. n.

In the dark colour of the body agrees with *G. italicus*, and is thus distinguishable at a glance from *G. glis*. The tail is, however, far less bushy and not quite so dark as in the former species, and the size of the animal is much smaller.

The dimensions of two specimens are as follows :—

Brit. Mus. Coll no.	Head and body.						
	Head.	Tail.	Hind foot.	Ear.	Length of upper molar crowns.	Length of lower molar crowns.	Length of nasals (measured along central line).
98. 10. 6. 4 & 5.	160	130	28	21	7	8	11 (no. 4)
♀ ♀, Monte Aspro, near Palermo, Aug. 30, 1898	151	126	19	16	7.10	8	11 (no. 5)

The type is no. 98. 10. 6. 4.

The Sicilian *Glis* thus appears to be a small local development of the large dark Italian species which I have recently described*. The skulls are unfortunately damaged, so that I am unable to give the total lengths, but they are markedly smaller and weaker than those of *G. italicus*, in which the cranial measurements corresponding to those given above have an average of (in a series of five specimens) 7.12, 8.3, 14.6 millim. A series of measurements of both *Glis glis* and *G. italicus* will be found in the Ann. & Mag. Nat. Hist. for November 1898, pp. 425, 426.

I am a little doubtful as to whether the Sicilian *Glis* should take specific or subspecific rank. It seems to be obviously an insular development of *G. italicus*; but, on the other hand, there are probably no intermediate and intergrading specimens between the two.

XXXVI.—*Descriptions of some new Species of Heterocera from Tropical America, Africa, and the Eastern Islands.* By HERBERT DRUCE, F.L.S. &c.

Fam. Syntomidæ.

Phenicoprocta cubana, sp. n.

Male.—Head and thorax black, spotted with metallic blue dots; antennæ black; collar and tegulæ bright orange;

* *G. italicus*.

abdomen bright orange above from the base to beyond the middle; the sides, anal segments, and underside bright carmine, the segments edged with metallic blue; fore coxæ white in front. Primaries hyaline, the veins, costal, inner, and outer margins edged with black, irrorated with metallic blue scales, the apex broadly black: secondaries hyaline, edged with black from the apex to the anal angle, the inner margin bright carmine.

Expanse $1\frac{1}{10}$ inch.

Hab. Cuba, San Cristobal (*Mus. Druce*).

Chrostosoma maratha, sp. n.

Female.—Head, thorax, abdomen, antennæ, and legs black; tegulæ edged with red. Primaries smoky hyaline, crossed beyond the middle from the costal margin to the anal angle by a wide semihyaline white band: secondaries hyaline; clouded with black at the apex and along the inner margin.

Expanse 1 inch.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

Cosmosoma entella, sp. n.

Male.—Head and collar metallic blue; antennæ black; the tegulæ, thorax, and abdomen bright red; the three anal segments of the abdomen black; a row of metallic blue spots extends down the middle and a similar row on each side; the underside of the abdomen black, the second and third segments broadly white. Primaries hyaline, the base red; costal margin, apex, outer and inner margins black; the veins black: secondaries hyaline, edged with black from the apex to the anal angle.

Expanse $1\frac{3}{4}$ inch.

Hab. Ecuador, Balsapamba (*Mus. Druce*).

Cosmosoma thia, sp. n.

Male.—Head, antennæ, and thorax black; tegulæ yellow; a small metallic blue spot at the base of the thorax; the first segment of the abdomen black, spotted with yellow on each side, the second, third, and fourth yellow, the anal segments metallic blue. Primaries hyaline, the costal and inner margins yellowish near the base, the veins brownish black, the apex and outer margin broadly black: secondaries hyaline, edged with black.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador, Chiquinda (*Buckley, Mus. Druce*).

Pseudomya trabea, sp. n.

Male.—Head, antennæ, thorax, abdomen, and legs black; the back of the head, sides of thorax, and base of the abdomen red; the first segment of the abdomen yellowish white. Primaries and secondaries smoky hyaline, darkest at the apex and round the outer margin.

Expanse 1 inch.

Hab. British Guiana (*Whitely*); Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

Holophæa melita, sp. n.

Male.—Head, antennæ, tegulæ, thorax, and abdomen dark blackish brown; a small crimson spot on the base of the thorax; the anal segments and sides of the abdomen bright metallic blue-green; the underside brownish white; legs brown. Primaries and secondaries uniformly dark brown.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador, Chiquinda (*Buckley*, *Mus. Druce*).

Euchromia Dohertyi, sp. n.

Male.—Head, antennæ, thorax, and abdomen black, the sides and underside of the abdomen banded with bright red; legs black. Primaries black, with a metallic blue streak at the end of the cell; a small hyaline spot close to the two about the middle, and three beyond the cell near the apex: secondaries black, the base and a large spot beyond the middle hyaline.—*Female* very similar to the male, but with the first segment of the abdomen red.

Expanse $1\frac{3}{4}$ inch.

Hab. Buru (*Doherty*, *Mus. Druce*).

Androcharta giganteum, sp. n.

Male and female allied to *A. meones*, but nearly twice the size; the secondaries of the male silky white, without the black margin, also much longer and much more pointed; the abdomen of each sex without the band of red spots down the middle as in *A. meones*.

Hab. Rio Napo (*Mus. Druce*).

Napata atalanta, sp. n.

Male.—Head, antennæ, thorax, and abdomen black; front of the head white; the anal segments of the abdomen banded

with white. Primaries brownish black, semihyaline from the base to about the middle; a small metallic blue dot close to the base: secondaries black.

Expanse 1 inch.

Hab. Amazons (*Leech, Mus. Druce*).

Aclytia pydna, sp. n.

Male.—Head, antennæ, tegulæ, and thorax dark brown, front of head and coxæ white; a yellow spot on each side of the head; abdomen above bright metallic blue, the sides dark brown, the underside white; legs dark brown. Primaries dark brown, the veins near the base yellowish; a bright yellow band crosses the wing beyond the middle from the costal almost to the inner margin: secondaries black, with a hyaline streak from the base almost to the outer margin.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

Eucereon mizar, sp. n.

Female.—Head, collar, and tegulæ brownish white; antennæ black; thorax and abdomen dark brown, the two anal segments orange: the underside banded with white. Primaries greyish white, shaded with brown, the veins all dark brown: secondaries dark brown, palest at the base.

Expanse $1\frac{1}{2}$ inch.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

Fam. *Zygænidæ*.

Procris (?) *chalestra*, sp. n.

Male.—Head, antennæ, thorax, abdomen, and legs bluish black. Primaries semihyaline black, darkest at the base: secondaries hyaline, broadly black at the apex and round the outer margin. —

Expanse 1 inch.

Hab. Costa Rica (*Van Patten, Mus. Druce*).

Zygæna muræna, sp. n.

Female.—Head, antennæ, and thorax black; collar and tegulæ pale yellow; abdomen bright red above the anal segment: underside and legs black. Primaries black; a large pale yellow spot close to the base, a round yellow spot in the form of a triangle about the middle of the wing, and an elongated yellow spot on the outer margin: secondaries

bright red, bordered with black at the apex and partly round the outer margin.

Expanse $1\frac{1}{4}$ inch.

Hab. South Africa, Potchefstroom (*Mus. Druce*).

This species is allied to *Z. cashmirensis*, Koll., from which it is at once distinguished by the red abdomen and entire absence of the black band on the secondaries.

Zygæna myodes, sp. n.

Male.—Head, antennæ, thorax, abdomen, and legs blue-black; tegulæ black, spotted with yellow at the base. Primaries blue-black, the base, a band crossing the middle, a round spot at the end of the cell, and an elongated spot on the outer margin all chrome-yellow: secondaries chrome-yellow, edged with blue-black.

Expanse 1 inch.

Hab. South Africa, Graham's Town (*Mus. Druce*).

A female of this species is in the National Collection; it is very similar to the male, but rather larger.

Harrisina tersa, sp. n.

Male.—Head, antennæ, thorax, abdomen, and legs black. Primaries and secondaries uniformly semihyaline black, the veins slightly more black at the base of the wings.

Expanse 1 inch.

Hab. Mexico, Orizaba (*Boucard, Mus. Druce*).

Fam. Arctiadæ.

Belemnina obscura, sp. n.

Male.—Primaries deep black, slightly bronze-green at the base; a fine reddish line beyond the cell, not extending to either margin: secondaries deep black. The head, antennæ, and thorax black; the abdomen deep metallic blue, underside of the abdomen red.

Expanse $1\frac{3}{4}$ inch.

Hab. Colombia, Bolivia (*Mus. Druce*).

Esthema eulalia, sp. n.

Primaries black, the apex edged with white; a curved white hyaline band, crossed by the black veins, beyond the middle of the wing, but not reaching either margin; the fringe black, excepting at the apex: secondaries black, shaded with dark blue along the inner margin from the base

to the anal angle; a band of white streaks partly crosses the wing beyond the middle nearest the apex; the fringe white. The head, antennæ, and thorax black; the abdomen bluish black above, the underside grey; legs greyish black.

Expanse $2\frac{1}{2}$ inches.

Hab. Upper Amazons (*Mus. Druce*).

This species is allied to *Esthema confluens*, Felder.

Esthema crocata, sp. n.

Primaries deep black, crossed by two white hyaline bands, the first about the middle, extending from the costal margin to the anal angle, the second close to the apex, both bands crossed by the black veins; a small white dot close to the base and one on the costal margin between the two white bands; the inner margin from the base to nearly the anal angle greyish blue; the fringe black: secondaries hyaline white, the veins bluish black; the costal margin, apex, and outer margin edged with black; the fringe black. The head, antennæ, and thorax black, the collar spotted with white, the abdomen bluish grey, the underside greyish white.

Expanse $2\frac{1}{4}$ inches.

Hab. Upper Amazons, Ecuador, Sarayacu (*Mus. Druce*).

A small species allied to *Esthema bicolor*, Cr.

Pericopis capella, sp. n.

Female.—Head and thorax brownish black, the front of the head and tegulæ spotted with yellow; antennæ and coxæ yellow; legs brown; abdomen pale brown, with three narrow black lines extending from the base to the anal segments, the sides and underside banded with yellow. Primaries brownish black, paler at the base, crossed from the costal margin by two bands, the first pale brown, the second brownish white; the veins black: secondaries yellow, broadly bordered with black from the apex to the anal angle; a marginal row of white spots extends from the apex to the anal angle: underside very similar to the upperside, but with the base of both wings red.

Expanse 3 inches.

Hab. Brazil (*Mus. Druce*).

Phuegoptera sebrus, sp. n.

Male.—Head, antennæ, collar, tegulæ, and thorax chrome-yellow; two small black dots behind the head and one on each of the tegulæ; 1 alpi yellow, with black tips; abdomen

pale brownish yellow, with black spots on each side near the anus; legs yellow. Primaries chrome-yellow, crossed beyond the middle by a narrow brown line, beyond which the wing is irrorated with brown scales; a brownish-yellow band crosses the wing from the costal to the inner margin: secondaries semihyaline yellowish white, darkest at the apex and anal angle.

Expanse $2\frac{1}{4}$ inches.

Hab. Bolivia (*Mus. Druce*).

A specimen of this species is in the National Collection from Peru.

Areas cana, sp. n.

Male.—Head bright red, antennæ black; collar white, edged with red, with two black dots in front; tegulæ and sides of thorax white; a black spot at the base and one on the middle of the tegulæ; the middle of the thorax black; abdomen bright red, with a row of central black dots: underside orange. Primaries pinkish white, the veins black; the inner margin and two oblique narrow bands crossing the wing black: secondaries bright red, slightly shaded with yellow round the outer margin; three black spots close to the anal angle.

Expanse $3\frac{1}{2}$ inches.

Hab. Sumatra (*Bock, Mus. Druce*).

Allied to *Areas galactia*, but very distinct.

Spilarctia Meeki, sp. n.

Female.—The upperside of the head and collar yellow; the front of the head, the antennæ, tegulæ, and thorax black; two black spots on the collar; the tegulæ edged with yellow; abdomen above red, with a row of black spots extending from the base to the anus: the underside black. Primaries reddish orange, the costal and inner margin yellow; a black spot at the base of the wing, two beyond; a curved black band at the end of the cell, in the middle of which is a small yellowish-white spot; a number of small black spots along the inner and outer margins, extending almost to the anal angle; a long wide black streak extends from the apex almost to the end of the cell; in some specimens the veins of the wing are yellow: secondaries bright red, with a black band at the end of the cell, and a submarginal row of rather large black spots extending from the apex to the anal angle, the outer margin edged with black at the apex.

Expanse $2\frac{1}{4}$ inches.

Hab. Trobriand Island, Kiriwini (*Meek, Mus. Druce*).

Euerythra apiola, sp. n.

Male.—Head, collar, and thorax brownish white; antennæ brownish white; abdomen yellow, with three rows of black dots from the base to the anus; the anus, underside, and legs brownish white. Primaries white, crossed by fine brown lines at the base and apex; a wide, central, brown pale band crosses the wing from the costal to the inner margin, where it extends from the anal angle almost to the base; secondaries creamy white, with a wide submarginal brownish band from the apex to the anal angle; the fringe white.—*Female* very similar to the male, but slightly larger.

Expanse, ♂ $1\frac{1}{2}$, ♀ 2 inches.

Hab. S.E. Brazil, St. Catharina (*Mus. Druce*).

Fam. Lithosiidæ.

Exotrocha tricolor, sp. n.

Male.—Head, antennæ, thorax, and abdomen black; the collar, tegulæ, and the underside of the abdomen bright red; legs black. Primaries red, shading to yellow at the base and along the inner margin; the costal margin, apex, outer margin, and half of inner margin edged with black: secondaries yellow, broadly bordered with black from the apex to the anal angle.—*Female* similar to the male, but larger.

Expanse, ♂ $1\frac{1}{4}$, ♀ $1\frac{3}{4}$ inch.

Hab. Dinner Island (*H. O. Forbes*); Trobriand Island, Kiriwini (*Meek*): *Mus. Druce*.

Exotrocha tegyra, sp. n.

Male.—Head, antennæ, thorax, abdomen, and legs black; collar, tegulæ, and the underside of the abdomen red. Primaries bright red; the costal margin, apex, outer margin, and half of inner margin broadly bordered with black, which extends from the inner margin across the wing almost to the costal margin: secondaries black, the basal half chrome-yellow.—*Female* similar to the male.

Expanse, ♂ $1\frac{3}{10}$, ♀ $1\frac{3}{4}$ inch.

Hab. Ferguson Island (*Meek, Mus. Druce*).

Fam. Lasiocampidæ.

Ormiscodes (?) *bætifica*, sp. n.

Male.—Head, antennæ, thorax, and legs reddish brown, the collar and tegulæ greyish white. Primaries white, the veins red, edged on both sides with brown; a black mark at the

end of the cell: secondaries white, the marginal end of the veins red, edged with brown; a round black spot at the end of the cell; the fringe of both wings reddish brown. Under-side white, the primaries shaded with red along the costal margin, the black spots as above.

Expanse 2 inches.

Hab. Paraguay (*Mus. Druce*).

Leiosoma hezia, sp. n.

Male.—Head, antennæ, collar, and tegulæ brown; abdomen reddish brown. Primaries pale brown, thickly irrorated with darker brown scales, crossed from the costal to the inner margin by four fine brown lines—the first near the base edged with white on the inner side, the second curved just beyond the cell, the third beyond edged with white on the outer side, the fourth submarginal, zigzag, extending from the apex to the anal angle: secondaries reddish brown, the costal margin pale greyish brown, the apex and two lines partly crossing the wing brown.

Expanse $1\frac{3}{4}$ inch.

Hab. Peru (*Mus. Druce*).

Leiosoma (?) *uzita*, sp. n.

Male.—Head, antennæ, collar, tegulæ, thorax, and abdomen pale fawn-colour. Primaries pale fawn-colour, shaded with brown near the apex and partly along the costal margin; five fine brown zigzag lines cross the wing from the costal to the inner margin: secondaries reddish fawn-colour, crossed about the middle by two fine brown lines, the outer margin shaded with darker brown.

Expanse 3 inches.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

Fam. Noctuidæ.

Perigea multipunctata, sp. n.

Male.—Head and palpi pinkish brown; the antennæ, thorax, and abdomen brown; the underside of the abdomen sordid white. Primaries pinkish white, the outer and inner margin and a band crossing the wing near the apex dark brown; the light-coloured part of the wing crossed by a number of pale brown lines: secondaries brownish white, shaded with darker brown at the apex and round the outer margin.

Expanse $1\frac{1}{2}$ inch.

Hab. West Africa, Mongo-ma Lobak, East Africa; Dar-es-Salaam (*Mus. Druce*).

XXXVII.—On the true *Podocerus* and some new Genera of *Amphipods*. By the Rev. THOMAS R. R. STEBBING, M.A., F.R.S., F.L.S., F.Z.S.

IN the family Podoceridæ it may well be supposed that the genus *Podocerus* ought to maintain the position which it has so long held unquestioned. To rebut this presumption it is necessary to weigh carefully the words used by Leach when instituting in 1814 (or 1813) the two genera *Podocerus* and *Jassa*. In his well-known article "Crustaceology" he combines these two in the second section of the family, his account commencing thus:—

"Superior antennæ shorter than the under ones; the last joint scarcely articulated.

"GENUS XI. PODOCERUS. Eyes hemispherical and somewhat prominent; four anterior feet didactyle, anterior pair smallest with an elongate-subovate hand; second pair with an ovate hand, and the internal side nearly strait.

"*Sp. 1. Variegatus*. Body, legs, and antennæ beautifully variegated with red.

"*Podocerus variegatus*, Leach's MSS.

"Inhabits the rocky shores of Devon, walking about on fuci and corallines with its antennæ as well as legs.

"GENUS XII. JASSA. Eyes not prominent; four anterior feet didactyle with ovate hands; the anterior pair smallest; the hand of the second pair with the internal edge furnished with teeth."

Then follows the account of *Jassa pulchella*, with two varieties, from Devonshire, and of *Jassa pelagica* "from the Bell Rock in the German Sea," and a note that "*Cancer (Gammarus) falcatus* of Montagu, *Lin. Trans.* vol. ix. tab. 5. fig. 2. seems referable to this genus."

From 1830 to the present time we have all with one consent accepted the view that Leach did not know what he was talking about, and most of us have believed that his two genera were one and the same. Some authors have held that all the three species above mentioned were simply synonyms of Montagu's *falcatus*. The real fact is that they may without impropriety be taken as representatives of three

distinct genera, not one of them with any certainty falling as a synonym to Montagu's species.

The description of *Podocerus variegatus* above quoted from Leach is far from suiting the account which Milne-Edwards appends to the name in his 'Histoire naturelle des Crustacés,' vol. iii. p. 63. He omits all mention of the hemispherical eyes, states that the second pair of hands have no teeth on the lower margin, and assigns a pretty strong median tooth to the hind margin of the last segment of the peræon and the first of the pleon. There is in truth only one Amphipod known as inhabiting the rocky shores of Devon which reasonably answers to the various characters indicated by Leach. This is the species described and figured by Bate and Westwood ('British Sessile-eyed Crustacea,' vol. i. p. 481) as *Cyrtophium Darwinii*. It has the proper colouring and habits; the eyes tally with the description, and the gnathopods have a sufficient correspondence. It is true that the ovate hand of the second gnathopod in the male has two processes on the internal side, but these are so concealed among the long fringing setæ that the general effect is that of a straight lower, inner, or hind margin. The under antennæ are conspicuously longer than the upper, and it is interesting to notice that "the last joint"—the flagellum—which Leach describes as "scarcely articulated," is shown in Bate and Westwood's figure of it as a single piece, though in the text they explain that it "consists of one very long and one or two minute terminal articuli." In regard to this species Bate and Westwood make, without seeing the bearing of it, the important observation that "some specimens (mixed with those of the genus *Podocerus*) have long existed unrecognized in the collection of the British Museum, procured by Dr. Leach probably from the south coast of Devon."

In the 'Règne Animal de Cuvier,' published after Cuvier's death, without dates, and variously cited as 3^e édit., édit. illustrée, or edit. Crochard, Milne-Edwards gives a representation of *Podocerus variegatus* (pl. lxi. fig. 4), purporting to be drawn from Leach's type in the British Museum. When one considers that the drawing must have been made some sixty years ago from a dried specimen more than twenty years old, minute accuracy is little to be expected. The two dorsal teeth, which Milne-Edwards, as above mentioned, describes in his later work, are doubtless due to an optical illusion with which every student of Amphipoda must now be familiar. In the so-called *Cyrtophium Darwinii* the imbrication of the segments which gives rise to the illusion is

very strongly marked. In the text of the 'Règne Animal,' p. 179, Milne-Edwards, copying Latreille, 1829, characterizes the species simply by three words—"A yeux saillans." As it happens they suffice, since the figure supplies a second striking feature in the greatly elongated terminal joint of the peduncle of the lower antennæ.

Cyrtophium Darwinii, on Spence Bate's own showing, ought to have been referred to Dana's other genus *Platophium*. Now, therefore, its identification with *Podocerus variegatus*, Leach, entails the cancelling of *Platophium*, the various species of which must be transferred to the far earlier *Podocerus*. The list, in my opinion, comprises the following ten species:—*andamanensis* (Giles); *brasiliensis* (Dana); *chelonice*, Stebbing; *chelonophilus* (Chevreux & de Guerne); *cristatus* (G. M. Thomson); *Dancæ*, Stebbing; *Darwinii* (Bate); *inconspicuus*, Stebbing; *lævis* (Haswell); *lobatus* (Haswell).

If this view of *Podocerus* be accepted, as I think it must, the obvious and necessary consequence is that *Jassa* will be upheld as a distinct genus, with the species *pulchella*, Leach, for its type. Whether the specific name *pulchella* should be retained is a separate question. Leach, as already noticed, instituted a second species of *Jassa* under the name *pelagica*, and suggested that Montagu's *Gammarus falcatus* might also belong to the genus. What Leach could not determine, later authors with more or less confidence, and with unanimity less rather than more, have settled for him. In the 'Règne Animal,' pl. lxi. fig. 2, Milne-Edwards claims to give a representation of Leach's *Jassa pelagica*, and in fig. 3 undoubtedly does represent Leach's *Jassa pulchella*. But in the text he refers both fig. 2 and fig. 3 to *Jassa pulchella*. Then, in the 'Hist. nat. des Crustacés,' 1840, he describes the species *Cerapus pelagicus*, with *Cancer falcatus*, Montagu, and *Jassa pelagica*, Leach, in the synonymy, thus acknowledging but disregarding the priority of *falcatus*. In this Guérin-Ménéville had set the example in the 'Iconographie du Règne Animal' by roughly copying Montagu's figure of *Gammarus falcatus*, and, without the least apology or explanation, calling it *Jassa pelagica*, Leach. As Lord Nelson was fond of saying, "Such things are." Subsequently the claims of *falcatus* were vindicated with so much vehemence that by some authors Leach's three species, *variegatus*, *pulchellus*, and *pelagicus*, have all been reduced to synonyms of it. But he must be a bold naturalist who will affirm that he knows for certain what Montagu's species

really is. The finger of the second gnathopods, figured with a strong tooth on the inner margin, and thus corresponding to the description "fangs falciform, with one tooth," will not suit any of the synonyms. Moreover, Montagu says:—"This curious and rare species inhabits the deep, amongst *Sertularia*, and *Algae*, and has only been taken by dredging at Tor-cross." No one in South Devon needs to go dredging for Leach's *pulchellus*. It is a common shore species. The possibility that *falcatus* is identical with *Herdmani*, Walker, and *odontonyx*, Sars (see A. O. Walker, Ann. & Mag. Nat. Hist. ser. 6, vol. xv. p. 472), is weakened by the fact that the specimens described by the later authors have a length less than half that recorded by Montagu, so that his species really remains, as it was left by Leach, indeterminate.

It has long been recognized, apparently on Norman's initiative, that the form which Spence Bate had named *Podocerus pelagicus* (Leach) was the female to the male form *pulchellus*. But by acute and diligent scrutiny of the specimens in the British Museum Mr. A. O. Walker has discovered that Leach's species *Jassa pelagica* corresponds not with Bates's female of *pulchellus*, but with Rathke's *Podocerus capillatus*. Around this latter form a curious mystification has gathered. In 1859 Bruzelius referred it to the genus *Jassa* of Leach, while to *Podocerus* he assigned two species, one of which belongs to *Ischyrocerus* of Krøyer and the other is a synonym of *Jassa pulchella*. Twelve years later Boeck erroneously identified Rathke's *capillatus* with *Podocerus variegatus*, Leach, but, instead of calling it by that name, he described it as *Janassa variegata*, at the same time making Leach's *pulchella* and *pelagica* the synonyms of a species which he called *Podocerus falcatus*, Montagu. He regarded *Jassa* of Leach as a synonym of *Podocerus*, and *Jassa* of Bruzelius as preoccupied by Münster in 1839 for the generic name of a fish, on these grounds introducing the name *Janassa*, the very one which was, in fact, as Mr. Smith Woodward tells me, preoccupied by Münster in 1832 for a well-known extinct fish. For this genus, therefore, the name *Parajassa* is now proposed, to comprise the two species *pelagica* (Leach) and *tristanensis*, Stebbing.

For the species *Podocerus cumbrensis*, Stebbing & Robertson, a new genus—*Microjassa*—is proposed. It nearly resembles *Jassa*, but has the side-plates of the second to the fourth pairs much deeper than the rest, and the large fourth pair conspicuously emarginate behind for the small fifth; the second antennæ are but little stronger than the first, the outer

plates of the maxillipeds are but scantily armed, and, as in *Ischyrocerus*, the first and second gnathopods of the female are but little unequal, though in the male the second is much larger than the first and differ in shape as well as size from those of the female.

To the family Dulichiidae I add the genus *Leipsuropus*. This is like *Cyrtophium*, Dana, except that the fifth segment of the pleon, though present, is devoid of appendages.

The name, signifying an omission of a uropod, refers to the important generic character. The genus contains at present only the Australian species described by Professor Haswell as *Cyrtophium parasiticum*.

In the Corophiidae a new genus is required for the New Zealand species described by Mr. G. M. Thomson as *Corophium excavatum*. The definition is as follows:—

Body compressed, side-plates continuous. First antennæ slender; flagellum consisting of several joints, without accessory flagellum. Second antennæ robust; flagellum slight, of more than three joints. Mandibular palp three-jointed. First gnathopods as in *Corophium*. Second gnathopods nearly as in *Corophium*, but having the long process of the fourth joint fringed on its front or inner margin, while the fifth is fringed on its hind margin, the two joints therefore, though fitting together, having no look of coalescence; the sixth joint with a small palm. Third peræopods the shortest, setose, strongly spined on the sixth joint. Fourth and fifth peræopods successively much longer, second joint of the third to the fifth pairs widely expanded. First uropods, and still more the second, stout, strongly spined; third pair small, outer ramus nearly as long as the peduncle, inner oval, minute. Telson short, entire.

For the species described by Professor Della Valle as *Siphonæcetes typicus*, Krøyer, I propose the name *S. Della-vallei*.

As personally I am strongly opposed to preliminary notices and duplicate publication in natural history, it should be explained that these notes are not a freewill offering on my part. They are submitted in compliance with the rules that govern contributors to 'Das Tierreich.' In the general revision of the Amphipoda readjustments of classification, appearing in their proper sequence, can be explained with more brevity and understood with more ease than when they have to be presented in isolation and detachment.

XXXVIII.—*Description of a new Osphromenoid Fish from the Congo.* By G. A. BOULENGER, F.R.S.*Anabas (Ctenopoma) fasciolata.*

No palatine teeth. Depth of body $2\frac{1}{4}$ to $2\frac{1}{3}$ in total length, length of head $3\frac{1}{4}$ to $3\frac{1}{3}$ times. Snout obtuse, a little shorter than the diameter of the eye, which is 4 times in length of head; interorbital space a little broader than diameter of eye; maxillary extending hardly to below anterior border of eye; 3 or 4 spines above and 1 or 2 below opercular notch; subopercle entire or indistinctly serrated; four series of ctenoid scales between the orbit and the angle of the præopercle. Dorsal XVI 8–9; last spine longest, half length of head; middle soft ray produced in a filament. Anal X 9–11. Dorsal and anal fins very narrowly separated from the caudal, which is rounded. Pectoral as long as head. Ventral produced into a filament, reaching fifth or sixth anal spine. Scales very finely striated, 27–28 $\frac{2}{3}$; lat. l. $\frac{14-15}{9-11}$. Pale brown, with 6 or 7 wavy darker vertical bars broader than the spaces between them; dorsal and anal fins edged with blackish; ventrals blackish.

Total length 70 millim.

Three specimens from Monseimbé, Upper Congo.

Presented to the British Museum by the Rev. J. H. Weeks.

The discovery of this new species, together with that of *A. nigropannosa* at the same locality, raises to four the number of species known from the Congo. *Ctenopoma nigropannosum* was described by Reichenow in 1875 (Sitzb. Ges. nat. Fr. Berl. p. 147) from specimens from the Loango Coast and the Gaboon; Günther, in 1896 (Ann. & Mag. Nat. Hist. [6] xvii. p. 269), overlooking Reichenow's description, renamed it *C. gabonense*. The four Congo species may be easily recognized by means of the following key:—

- I. Caudal peduncle short but very distinct, the space between the anal and caudal fins equalling at least the diameter of the eye; subopercle strongly serrated.

Dorsal with 19 or 20 spines; ventral not reaching anal; maxillary extending to below centre of eye ..

Dorsal with 17 spines; ventral extending far beyond origin of anal; maxillary extending to below anterior fourth of eye *A. nigropannosa*, [Reichen.
A. conyica, Blgr.

- II. No distinct caudal peduncle, the dorsal and anal fins nearly reaching the caudal; subopercle entire or indistinctly serrated; dorsal with 16 or 17 spines.

Ventral reaching far beyond origin of anal; length of head much less than depth of body, $3\frac{1}{4}$ to $3\frac{1}{2}$ in total length; maxillary hardly extending to below anterior border of eye *A. fasciolata*, Blgr.

Ventral extending to origin of anal; length of head equal to depth of body, $2\frac{1}{2}$ to $2\frac{3}{4}$ in total length; maxillary extending to below anterior fifth or anterior third of eye *A. Weeksii*, Blgr.

Anabas (Ctenopoma) Petherici, Gthr., does not occur in the rivers flowing into the Atlantic. Specimens from the Gaboon have recently been referred to it by Günther; but I find on careful examination that they really belong to *A. (C.) Kingsleyæ*, Gthr., which differs from the White Nile species in the absence of spines on the scales behind the eye. The depth of the body is $2\frac{1}{2}$ to $2\frac{1}{2}$ in the total length ($2\frac{3}{4}$ to 3 in *A. Petherici*), and the anal spines number more frequently 9 than 10.

Ct. microlepidotum, Gthr., is identical with *Sandelia Bainsii*, Casteln. I have not yet been able to ascertain which specific name has priority.

The genera *Ctenopoma*, *Spirobranchus*, and *Sandelia* cannot be upheld. The types of all three have the air-bladder bifid behind and prolonged into the caudal region, as in *Anabas*, and the palatine teeth may be absent in specimens otherwise referable to *Ctenopoma*.

XXXIX.—*Description of Two new Butterflies collected by Major E. M. Woodward in Nandi, Equatorial Africa.*
By EMILY MARY SHARPE.

Family Nymphalidæ.

Neptis Woodwardi, sp. n.

Allied to *N. incongrua*, Butler (P. Z. S. 1896, p. 112, pl. vi. fig. 2), from Nyasaland.

This species differs from the allied form in the absence of light spots on the inner margin of the primaries, and no spots are visible at the end of the discoidal cell, so that the

whole of the basal half of the wing is uniform brown. The band on the secondaries which crosses the centre of the wing from the costa to the inner margin is ochraceous and slightly broader than in *N. incongrua*, which has this band white.

Underside. General colour pale brown, the nervules and a patch near the discoidal cell of the primaries darker brown. Secondaries pale brown, the nervules and hind marginal border slightly darker, with a very distinct and dark brown patch well pronounced towards the apex. The light markings on the upperside of both wings are very distinctly reproduced below.

Expanse 2.1 inches.

Hab. Nandi, Uganda Protectorate, 13th March, 1898 (*E. M. W.*).

Family Acraëdæ.

Planema nandensis, sp. n.

Allied to *P. flava*, Dewitz, but altogether smaller. The blackish band on the primaries which crosses from the discoidal cell unites with the hind margin, and is distinctly narrower than in *P. flava*, as are also the brown apical and hind marginal borders. Secondaries entirely ochre-yellow, the brownish hind margin being very much narrower as compared with that of the allied form.

Underside. The dark brown borders of the upper surface are reproduced on the underside by a mere representation of dusky brown, but the cross-band on the primaries at the end of the discoidal cell is equally strongly marked as on the upper surface, though there is no connexion with the hind marginal border. The secondaries have a cluster of nine minute spots near the base, the central area of the wings being ochre-yellow, with the nervules and marginal border dusky brown.

Expanse 1.7 inch.

Hab. Nandi, Uganda Protectorate, 16th March, 1898 (*E. M. W.*).

This species is doubtless nearly allied to *Acraea disjuncta* of Mr. Grose-Smith (Nov. Zool. v. p. 351, 1898), but there are many points of difference, which will be readily seen on comparing his description with the one given above.

XL.—On some Tertiary Foraminifera from Borneo collected by Professor Molengraaff and the late Mr. A. H. Everett, and their Comparison with similar Forms from Sumatra. By R. BULLEN NEWTON, F.G.S., and RICHARD HOLLAND.

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 - (5) — (—) *sumatrensis*, Brady.
 - (6) — (*Discocyclina*) *stellata*, d'Archiac.
 - (7) Other Orbitoides.
- (C) Linderina :
 - (8) *Linderina*, sp. indet.
- (D) Cyclocypeus :
 - (9) *Cyclocypeus*?, sp. indet.
- (E) Other Foraminifera :
 - (10) *Miliolina*, *Spiroloculina*?, *Planispirina*, &c.

INTRODUCTION.

(1) *Previous Work on the Tertiary Foraminifera of Borneo.*
—The presence of a Nummulitic formation in Borneo appears to have been first recognized by Dr. Schwaner in 1844 during his explorations in the southern part of the country (Riam Kiwa district), although the fact was not published until 1857*, several years after his death.

C. de Groot† next refers to the same rocks as containing

* Anon., "De Steenkolen in het rijk van Bandjermassin," Tijdsch. Nederl.-Indië, 1857, vol. ii. pp. 129-156 (from papers left by Dr. Schwaner, written about 1844).

† "Zuid- en Oosterafdeeling van Borneo," Nat. Tijdsch. Nederl.-Indië, 1857, vol. xiv. pp. 40-49.

Nummulites; but it was reserved for P. van Dijk* in 1858 to first determine the forms and to identify them as of "Suessonien" age, the species being as follows:—*Nummulina depressa*, Orb., *N. lenticularis*, Bronn, *N. mamilla*, Höninghaus, and *N. polygyrata*, Deshayes.

A further reference to these Nummulites was made by C. de Groot† in a letter to Sir Roderick Murchison during 1863, a list of species being given which corresponded exactly with van Dijk's of 1858.

To Dr. R. D. M. Verbeek‡ we are, however, indebted for the earliest published figures and descriptions of Bornean Foraminifera, issued in 1871. His specimens were obtained, also from the southern part of the island, at Riam Kiwa, Pengaron, &c., and were determined as *Nummulites pengaronensis* (sp. n.), *N. sub-Brongniarti* (sp. n.), *N. biaritzensis*, Archiac, and *N. striata*, Orb., var. *f* (var. nov.), *Orbitoides discus*, Rüttimeyer, *O. Pratti*, Michelin, *O. papyracea*, Orbigny, *O. Fortisi*, Archiac, &c., all of which were referred to the Eocene period.

In 1878 Dr. K. von Fritsch§ made a further study of a similar series of forms from Southern Borneo, and described them as occurring in the Orbitoidenschichten division of the Eocene beds, under the following names:—*Nummulites sub-Brongniarti*, Verbeek, *Orbitoides papyracea*, Boubée, *O. ephippium*?, Schloth., *O. omphalus*, sp. n.?, and *O. decipiens*, sp. n.?

In 1882 Prof. K. Martin|| identified *Orbitoides dispansa* and *Nummulina* in the Teweh district and near Martapura (S. Borneo) as of probably Eocene age; but such forms as *Cycloclypeus*, *Rotalia*, *Globigerina*, *Orbitoides*, *Textularia*, and *Amphistegina*, which came from Tungang, on the River Barito, of South Borneo, he regarded as Miocene. Dr. T. Posewitz¶ next referred to the Foraminifera found near

* "Over der Waarde van eenige Nederlansch-Indische Kolensoorten," Nat. Tijdsch. Nederl.-Indië, 1858, vol. xv. pp. 139-158.

† "Notes on the Mineralogy and Geology of Borneo and the adjacent Islands," Quart. Journ. Geol. Soc. 1863, vol. xix. p. 515.

‡ "Die Nummuliten des Borneo-Kalksteines," Neues Jahrbuch, 1871, pp. 1-14, pls. i.-iii.; "De Nummulieten uit den Eoceenen Kalksteen van Borneo," Jaarb. Mij. Ned. O.-Indië, 1874, vol. ii. pp. 133-161, plate (=reprint of the 1871 paper).

§ "Einige Eocene Foraminiferen von Borneo," Palæontographica, 1878, Suppl. vol. iii. pp. 139-143, pls. xviii., xix.

|| "Neue Fundpunkte von Tertiär-Gesteinen im Indischen Archipel; nach Sammlungen von Horner, Korthals, Macklot, Müller und Reinwardt," Samml. geol. Reichs-Museums Leiden, 1882, pp. 132-147.

¶ "Geologische Notizen aus Central-Borneo (Das Tertiäre Hügelland bei Teweh)," Nat. Tijdsch. Nederl.-Indië, 1884, vol. xliii. pp. 169-175.

Teweh (Central Borneo) as being similar to those described by Verbeek from the Pengaron district.

Mr. A. V. Jennings *, in 1888, contributed an interesting account of the Orbitoides composing the Silungen and Batu Gading limestones of Northern Borneo, from material supplied him by Mr. H. T. Burls, F.G.S, identifying the following forms:—

- Orbitoides (Discocyclina) papyracea*, Boubée.
 — (—) *applanata*, Gümbel.
 — (—) *ephippium*, } J. de C. Sowerby.
 — (—) *dispana*, }
 — (*Asterocyclina*) *stellata*, Gümbel.

The author particularly notes the absence of *Nummulites* in these limestones, and regards the species enumerated as indicative of a later date than Eocene.

A valuable report was issued by Dr. M. von Hantken † in 1889 on an examination of some rocks from Batu-Bangka, South Borneo, in which the following specimens, referred to an Upper Eocene age, were identified:—

Orbitoides dispana, Sby., *O. papyracea*, Boubée, *Heterostegina* (like) *reticulata*, Rüttimeyer, *Nummulites* (rare), *Rotalia*, *Globigerina*, *Bolivina*, *Pulvinulina*, *Clivulina cylindrica*, Hantken, = *C. rudislostia*, sp. n., *Gaudryina Reussi*, Hantken, *Chilostomella cylindroides*, Reuss, *Marginulina subbullata*, Hantken, *Cassidulina globosa*, Hantken, *Globigerina bulloides*, Orb., *G. triloba*, Reuss, *Pseudotruncatulinu Dutemplei*, Orb., *P. propinqua*, Reuss, *Plecanium*, &c.

Dr. J. W. Retgers ‡, in 1895, records the occurrence of Foraminifera (*Nummulites* and *Orbitoides*) in different limestones obtained from localities on the east coast of Borneo, but without reference to their geological age.

(2) *The late Mr. A. H. Everett's Specimens.*—The late Mr. A. H. Everett §, a few years since, presented to the

* "Note on the Orbitoidal Limestone of North Borneo," Geological Magazine, 1888, pp. 530-532, pl. xiv.

† Included in Dr. T. Posewitz's 'Borneo,' 1839, pp. 383, 384 (published in Berlin); see also English translation of this work by F. H. Hatch, 1892, p. 491.

‡ "Mikroskopische Beschrijving van Gesteenten afkomstig van de Oostkust van Borneo," Jaarb. Mijn. Nederl. Oost-Indië, 1895, vol. xxiv. pp. 78-98.

§ Mr. Everett died in London on the 18th of June, 1898, after spending the greater part of his life in Borneo. He was a clever naturalist and collector, having identified himself with the avifauna of the country besides becoming an authority on its geology in connexion with mineral

British Museum a series of limestone specimens which he collected in various parts of Borneo during a long residence in that island, with a request that the organisms contained in them might be examined, so that a satisfactory conclusion might be arrived at respecting their probable geological age. It was found on examination that these specimens were divisible into two distinct groups—one Mesozoic, the other Tertiary. The former series, already referred to by one of us* in a published communication, included limestones obtained from localities in the western end of the Sarawak province on or near the river of the same name, which were largely composed of coral, bryozoan and sponge structures, and regarded as belonging to the Middle Oolite division of the Jurassic system.

The Tertiary limestones, containing the Foraminifera now about to be described, were collected in two widely distant regions of Borneo, some being found in the Malinam River (a tributary of the River Baram), which flows between the limestone-mountains of Molu and Barib, near the boundary of the Brunei and Sarawak divisions of the country; whilst the remainder were obtained from Gomanton Hill, in the Kinabatangan district, north-east of the island, a locality much celebrated for some rich guano-deposits which are worked there.

From their occurrence in a river-bed the Malinam-River limestones are naturally rounded and waterworn; when cut and polished, or if their external surfaces are merely wetted, they are found to contain numerous Foraminifera, as well as calcareous algæ (*Lithothamnium*) &c.

In these limestones we have determined the following specimens:—

- Nummulites javanus*, Verbeek. Forms A and B;
- Orbitoides* (*Lepidocyclus*) *Verbeeki*, sp. n.;
- (—) *sumatrensis*, Brady;
- (*Discocyclus*) *stellata*, Archiac;

and other Discocycluses, *Cycloclypeus*, and many Milioline and Rotaline forms.

distribution and the origin of the limestone-caves. On these subjects he contributed several papers to the scientific journals. His loss will be greatly felt by all those interested in the natural history of Borneo.

* R. B. Newton, "On a Jurassic Lamellibranch and some other associated Fossils from the Sarawak River Limestones of Borneo; with a Sketch of the Mesozoic Fauna of that Island," Geol. Mag. 1897, pp. 407-415.

The Gomanton-Hill rock is a cream-coloured limestone, much less crystalline than that from the Malinam River, and containing a small percentage of phosphate (information kindly given us by Mr. G. T. Prior, of the British Museum). So far as our examination has gone, we have observed no Nummulites in this limestone, its structure yielding *Orbitoides* (*Lepidocyclina*) *sumatrensis*, Brady, *Linderina*, sp., together with numerous forms of Miliolines and Rotalines.

(3) *Professor Molengraaff's Specimens*.—Professor Molengraaff's specimens were obtained during his expedition to Central Borneo in the years 1893 and 1894, of which a geographical notice * and a preliminary geological report † have already been published.

In his account of the fossils, however, Dr. Krause excludes all consideration of the Radiolaria and Nummulites, specially stating that the former were under description by Dr. G. J. Hinde and the latter by Professor Schlumberger (see p. 170 of Krause's paper).

When Professor Molengraaff visited the British Museum in the spring of 1897 he requested one of the present writers to undertake an examination of his Bornean Foraminifera, mentioning at the time that they had been placed before Professor Schlumberger, of Paris, who had been obliged to return them unidentified on account of their very imperfect preservation. The specimens and microscopical preparations were therefore duly forwarded to the British Museum from the Laboratory of Mineralogy at Amsterdam ‡, an examination of which proved the presence of *Nummulites Djokdjokartæ*, K. Martin, a species common to the Oligocene rocks of Sumatra and Java, occurring in boulder no. 985; *Discocyclina*, a subgenus of *Orbitoides*; and possibly *Amphistegina*.

The Molengraaff material is in the form of boulders mostly composed of a coarse quartz conglomerate, although the largest (nos. 984 and 986, in two pieces) is of somewhat different structure, being more of the nature of a grey felspathic grit, with intercalated lustrous black patches of a carbonaceous substance. Throughout this mass foraminiferal remains are

* G. A. F. Molengraaff, "Die Niederländische Expedition nach Zentral-Borneo in den Jahren 1893 u. 1894," Petermann's 'Mittheilungen,' 1895, vol. xli. p. 201.

† P. G. Krause, "Ueber Tertiäre, Cretaceische und ältere Ablagerungen aus West-Borneo," Samml. geol. Reichs-Mus. Leiden, 1897, vol. v. ser. 1, p. 169.

‡ This was effected through the kindness of Mrs. Molengraaff, her husband having started for Pretoria to take up his new position of State-Geologist to the South African Republic.

fairly abundant, being rather more easily discernible near the outer surface, where they occur as reddish-brown casts, considerably decomposed. Two microscopical sections have been made from boulder no. 984, which is a matrix of black colour and crowded with Nummulites. None of the other boulders having been fractured, we are unable to say anything respecting their internal characters.

All the boulders were obtained from the river-beds of Embalau, Tekelan, and Sajang, offshoots of the great Kapuas River in its uppermost regions, being numbered as follows under a group termed Series I. :—

- No. 982. River Tekelan.
 983. River Embalau (right bank), $\frac{1}{2}$ kilom. below R. Sajang.
 984. River Embalau.
 984. }
 985. } River Tekelan.
 986. }
 987. }

The distinguishing numbers on the microscopical sections are :—

- V. 1648 & V. 1650, made from Boulder no. 984.
 V. 1644, V. 1645, V. 1646, and V. 1647, made from Boulder no. 986.

(4) *Age of the Specimens.*—In determining the geological horizons of the specimens described in this paper we have been mainly guided by the carefully worked out results of the Javan Foraminifera as set forth in Verbeek and Fennema's important monograph entitled 'Description géologique de Java et Madoura.' The authors mentioned have limited *Orbitoides* to two subgenera instead of five as originally proposed by Gümbel, viz. *Discocyclina* and *Lepidocyclina*, characteristic of different parts of the Tertiary system. As we show later on, Messrs. Verbeek and Fennema hold that *Discocyclina*, having simple rectangular chambers in the median plane, as found in the Indian Archipelago, belongs entirely to Eocene and Oligocene rocks; whereas *Lepidocyclina*, with rounded chambers, never occurs in this area in older deposits than Miocene, and apparently becomes extinct during Pliocene times. Similarly with regard to the Nummulites we can recognize an Eocene and Oligocene age respectively for *Nummulites javanus* and *N. Djokdjokartæ*, species found both in Borneo and Java.

The foregoing considerations would lead us to conclude that the Malinam-River pebbles may be referred to two periods—(1) an Eocene, determined by the presence of

Nummulites javanus and *Orbitoides (Discocyclina) stellata*; and (2) a Miocene or Pliocene, characterized by *Orbitoides (Lepidocyclina) Verbeeki* and *O. (L.) sumatrensis*.

Again, the Gomanton-Hill limestone would appear to represent a Miocene or Pliocene age, on account of its structure exhibiting forms of *Orbitoides (Lepidocyclina) sumatrensis*; and, lastly, the "Molengraaff" boulders from West-central Borneo, in which we have identified *Nummulites Djokdjokartæ* and *Orbitoides (Discocyclina)*, may be regarded as belonging to the Oligocene formation.

Tertiary Foraminifera are widely distributed over the islands of the Indo-Pacific area; and although our knowledge is more complete concerning those forms found in Sumatra, Java, and Borneo, we are not without evidence of their occurrence in Timor*, Celebes†, the Philippines‡, and eastwards to New Guinea§. Moreover at Christmas Island, some 200 miles south of Java, Mr. C. W. Andrews§ has recently discovered limestones containing *Orbitoides* and other Foraminifera underlying a comparatively recent coral-formation. These limestones, when properly investigated, will add a new interest to the geology of this region.

Before concluding this introductory portion of our work, some acknowledgments are due to those friends who have assisted us in the preparation of this paper. To Mr. H. W. Burrows we are greatly indebted for the careful microphotographs he has produced of our slides, the negatives of which he has generously allowed us to use for our illustrations on the present occasion; we have also to thank Mr. Burrows for his otherwise kindly help and interest shown us during our examination of the Bornean rocks. We wish to tender our thanks to Dr. Harmer for the loan of that portion of Brady's type material from Sumatra which is preserved in the University Museum of Zoology at Cambridge, the remainder being in the British Museum at South Kensington. Our

* K. Martin, "Palæontologische Ergebnisse von Tiefbohrungen auf Java, nebst allgemeineren Studien über das Tertiär von Java, Timor, und einiger anderer Inseln," Samml. geol. Reichs-Mus. Leiden, 1887, vol. iii. no. 15, p. 310 (Timor), p. 362 (Celebes).

† F. von Richthofen, "Ueber das Vorkommen von Nummulitenformation auf Japan und den Philippinen," Zeitschr. deutsch. geol. Ges. 1862, vol. xiv. p. 357.

‡ K. Martin, "Eine Tertiärformation von Neu-Guinea und benachbarten Inseln," Samml. geol. Reichs-Mus. Leiden, 1881, vol. i. no. 2, p. 72.

§ Information contained in an Address read before the Royal Geographical Society, November 28th, 1898, and published in 'The Geographical Journal' for January 1899; see also Geol. Mag. 1899, January, no. 415, p. 25.

thanks are also due to Professor Molengraaff for granting us the privilege of studying his interesting specimens from West-central Borneo. Finally we may state that our studies of the "Everett" limestones have been greatly facilitated by the excellent microscopic sections prepared for us by Mr. Richard Hall, the assistant-formatore of the British Museum at South Kensington.

DESCRIPTION OF THE FORAMINIFERA.

(A) NUMMULITES.

1. *Nummulites javanus*, Verbeek, form B.
(Pl. IX. figs. 1, 2, 3.)

Nummulites javanus, vars. A (*soloensis*), B, C, D, Verbeek, "Voorloopig Bericht over Nummulieten, Orbitoiden en Alveolinen van Java &c.," Nat. Tijdschr. v. Nederl.-Indië, 1891, vol. li. pp. 105, 106, figs. 1, 2, 3; R. D. M. Verbeek and R. Fennema, Desc. géol. Java et Madoura, 1896, vol. i. pl. iii. figs. 45-57, pl. iv. figs. 58-68, pl. v. figs. 69-73, and pl. vii. fig. 94, vol. ii. p. 1143 *et seq.*

Shell lenticular; edge somewhat obtuse; one surface more convex than the other; sometimes the shell in vertical section appears plano-convex or even concavo-convex; the majority of the vertical sections show a slight sigmoidal curvature; surface probably smooth, but none of our specimens have been obtained free from the matrix. The "columns," however, do not pass up through the vertical section sufficiently strongly to produce tubercles upon the surface, though there might be slight external markings. The "filets cloisonnaires," or alar prolongations of the septa, are subreticulate, and are well shown in horizontal section in Pl. IX. fig. 3. This figure is strictly comparable with figs. 67 and 68 in plate iv. of Verbeek's work mentioned above; and it will be seen from our figure that "les piliers sont grenus en coupe," as Verbeek describes them in his Javan specimens.

The mean dimensions of the Bornean specimens are 20 millim. in diameter by 4 millim. in thickness; but in all, or nearly all these specimens, the actual size must have been somewhat greater, because the external surface of the shells has suffered more or less corrosion in the process of fossilization. There are about 26 turns of the spiral in a radius of 10.5 millim. and 16 chambers in $\frac{1}{4}$ turn at a radius of 5 millim. The coiling is, however, irregular. The chambers differ considerably in size even in the same convolution, though not to the extent apparently shown in Pl. IX. fig. 2. That figure is deceptive, as all thin sections of *Nummulites* cut on the

horizontal plane must be, because no strictly horizontal plane will exactly pass through the middle of every chamber in the median section. The central chamber is invisible.

These large Nummulites are undoubtedly identical with one or other of the four varieties of *N. javanus* described by Dr. Verbeek, and the species is closely related to the well-known *N. lævigata* of Europe. Dr. Verbeek may be cited in support of this view as to the affinities of the species. He describes as *N. lævigata* one of his Javan Nummulites, and goes on to say (*op. cit.* p. 1152):—"La seule différence entre cette espèce et la *N. lævigata* d'Europe (notamment telle que Carpenter la décrit et la représente dans le Quart. Journ. of the Geol. Soc. vol. vi. 1850, pl. iii. fig. 2, car la description et les figures de cette espèce par d'Archiac ne sont pas toujours exactes), c'est l'aspect plus ponctué de la surface et le nombre un peu plus considérable des tours de spire pour une même rayon. . . . Notre espèce a aussi beaucoup d'analogie avec le *N. javanus* var. δ , tant pour le nombre des tours de spire que pour celui des loges, de sorte qu'il faut peut-être la considérer comme une 5^e variété de notre *N. javanus* à cloisons moins arquées et à piliers plus épais."

The figure by Carpenter to which Dr. Verbeek refers above is that of a *N. lævigata* from the Bracklesham Beds in Sussex, which differs very considerably from the typical *N. lævigata* of the Paris Basin and Belgium—differs, in fact, as widely as other Nummulites which have been ranked as separate species. *N. javanus* departs from the typical *N. lævigata* in a somewhat opposite direction, but hardly perhaps more widely. That the Bornean specimens are very close allies of *N. lævigata* is further shown by their association with a form having a large initial chamber and bearing a strong resemblance to *N. Lamarcki*, the European companion of *N. lævigata*.

This association of Nummulites, first indicated by Messrs. Parker and Jones (*Ann. & Mag. Nat. Hist.* ser. 3, vol. viii. 1861, p. 233), is a very well-known phenomenon. Every student of these fascinating organisms is aware that Nummulites almost always, if not invariably, occur in pairs of so-called "species." One of the members of the couple is generally larger than its fellow, and has always a very minute or even invisible initial chamber, while the other member, which never attains a large size, is distinguished by the possession of a comparatively large initial chamber. Each member of such a couple has been looked upon as a distinct species, and has been named accordingly. The propriety of the distinction has been questioned by several authors, but

the general view of writers on Nummulites has been that expressed by the diverse nomenclature. Of late years, however, considerable attention has been given to the study of the initial and immediately succeeding chambers of the shells of the Foraminifera, and notably by MM. Schlumberger, Munier-Chalmas, and Van den Broeck. Mr. J. J. Lister, too, has closely studied the life-history of *Polystomella*, a genus nearly allied to *Nummulites*. The result of the researches of these and other observers * is to show that many species of Foraminifera are dimorphic, and it seems to be probable, in the light of Mr. Lister's observations, that the coupled forms of Nummulites represent alternate generations of one species. In any case it seems to be desirable that the nomenclature should express relationship between the companion forms, and it appears that there is more advantage, in the present state of our knowledge, in considering paired forms as varieties of one species than as specifically distinct. We therefore, following the rule of M. Schlumberger as regards other Foraminifera, designate this large form with minute initial chamber *N. javanus*, form B, and the smaller companion with large initial chamber *N. javanus*, form A.

2. *Nummulites javanus*, Verbeek, form A.
(Pl. IX. figs. 4 & 5.)

Nummulites baguelensis, Verbeek (pars), Nat. Tijdsch. Nederl.-Indië, 1891, vol. ii. p. 107; Description géologique de Java et Madoura, 1896, vol. i. pl. iii. fig. 75, pl. vi. figs. 81-85, vol. ii. p. 1148.

Shell lenticular; regularly swollen at the centre; edge obtuse; surface probably smooth; "filets cloisonnaires" subreticulate. The mean dimensions of our specimens are 3.2 millim. in width by 1.8 millim. in thickness, but these measurements are probably rather less than the actual for the reason given in the description of the form B. The number of convolutions is usually 4 or 5. We have not found in our preparations any good horizontal sections, but we have enough to show that the size and irregular shape of the initial chamber, the generally semilunar shape of the first succeeding chamber, the dimensions of the chambers in the spire, and the closing-in of the later convolutions constitute a

* Bull. Soc. Géol. France, sér. 3, vol. viii. 1880, p. 300; Comptes Rendus, vol. xcvi. 1883, pp. 862-866 and pp. 1598-1601; Ann. & Mag. Nat. Hist. ser. 3, vol. xi. 1883, pp. 340, 341; Bull. des Séances de la Soc. roy. Malacol. de Belgique, 1893, tom. xxviii.; Phil. Trans. vol. 186, 1895, pp. 401-453; Proc. Camb. Philosophical Soc. 1897, vol. ix. part 5, pp. 236-240. See also T. R. Jones, Ann. & Mag. Nat. Hist. 1894, ser. 6, vol. xiv. pp. 401-407.

strong resemblance to the characters of *N. Lamarcki*, the European companion of *N. lævigata*. *N. javanus*, form A, differs from *N. Lamarcki* chiefly in its fewer convolutions and its rather more robust habit of growth.

Here and there in the same slides with *N. javanus*, form A, we have met with vertical sections of rather smaller Nummulites less robustly built than their companions and with the initial chambers measuring .12 millim. in width. We are inclined to think that these Nummulites are variants of *N. javanus*, form A, corresponding to the variety of *N. Lamarcki* figured by d'Archiac and Haime in pl. iv. fig. 16 of their monograph.

Occurrence. *N. javanus* (both forms) occurs in our material only in two pebbles from the bed of the River Malinam. In one pebble particularly it occurs in great profusion.

3. *Nummulites Djokdjokartæ*, K. Martin (sp.).

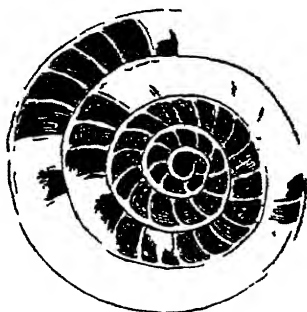
Nummulites Lamarcki, R. D. M. Verbeek, "Tertiärformation von Sumatra," Palæontographica, 1880, Suppl. 3, Lief. 8, Theil 1, p. 23 (non Archiac and Haime).

Nummulina Djokdjokartæ, K. Martin, "Tertiär-Versteinerungen vom östlichen Java," Samml. geol. Reichs-Mus. Leiden, 1881, no. 2, p. 110, pl. v. figs. 9-11.

Nummulites Joggjakertæ, R. D. M. Verbeek, "Voorloopig Bericht over Nummulieten, Orbitoiden en Alveolinen van Java, &c.," Nat. Tijdschr. v. Nederl.-Indië, 1891, vol. li. pp. 116, 117, figs. 1-3 on plate.

Nummulites Joguiakartæ, R. D. M. Verbeek and R. Fennema, Description géologique Java et Madoura, 1896, vol. i. pl. viii. figs. 114-119, vol. ii. p. 1152.

To this species we refer certain specimens which occur in the material collected by Prof. Molengraaff. This material, as



Nummulites Djokdjokartæ, K. Martin (sp.).
(Magnified 12 times.)

already stated, consists of small boulders and a few microscopic sections cut from two of them. On chipping one of

the boulders (no. 984) specimens of *N. Djokdjokartæ* in a very decayed condition are here and there met with. The specimen figured measured 3·5 millim. in width and the central chamber measured ·28 millim. The number of convolutions was 4 or 4½, and the number of chambers in the spire was about 64. The thickness of the specimen (judging from the cast in the matrix) appears to have been from 1 to 2 millim.

Prof. Molengraaff's slides contain various more or less obscure sections of Nummulites. Some of them are possibly referable to this species, others possibly belong to an alternate form of the same or to distinct species; but they do not happen to be cut so as to enable us to determine their characters. One of these indeterminate sections is shown in Pl. IX. fig. 6.

Occurrence. Prof. Molengraaff's material was obtained from the beds of the Rivers Embalau and Tekelan.

(B) ORBITOIDES.

In the Appendix to the valuable work on the Geology of Java and Madoura already referred to Dr. Verbeek gives a very interesting chapter on the Orbitoides met with. He reviews much of the work of other writers upon the genus, and expresses himself in favour of reducing Gümbel's * five subgenera to two—that is to say, he would unite *Discocyclina*, *Rhipidocyclina*, *Aktinocyclina*, and *Asterocyclina* under the subgenus *Discocyclina*, comprising all Orbitoides having rectangular chambers in the median plane; and for the second subgenus he would retain Gümbel's *Lepidocyclina*, comprising the Orbitoides with rounded chambers in the median plane. We quite agree in this arrangement. It appears to us that the division into subgenera on the basis of the characters of the chambers of the median plane is likely to give satisfactory results, while divisions based on the external form or ornamentation of the shells, such as "*Rhipidocyclina*," "*Aktinocyclina*," and "*Asterocyclina*," must lead to confusion. We say this particularly because in the study of our Bornean material we have come across fragments which, while they are not sufficiently perfect for description, give us good ground for expecting that specimens will presently be met with having the external form of Gümbel's *Asterocyclina*, for instance, coupled with the lozenge-shaped or spatuliform median chambers which are characteristic of *Lepidocyclina*.

We think it not improbable that the *O. (Asterocyclina) stellata* figured by Vaughan Jennings in his paper on the

* "Beiträge zur Foraminiferen-Fauna der nordalpinen Eocäugebilde," Abhandl. k. Bayer. Akad. Wiss. Classe ii. Band x. (1868).

Orbitoidal Limestone of North Borneo (Geol. Mag. dec. iii. vol. v. 1888, pl. xiv. fig. 7) may belong to the *Lepidocyclina* rather than the *Discocyclina* group.

Dr. Verbeek ventures to put forth an important generalization based on his study of the *Orbitoides* of Java and the neighbouring lands. He writes:—"Dans toutes les couches, caractérisées comme éocènes par la présence de nummulites et d'alvéolines, il existe de nombreuses discocyclines (y compris des rhipido-, des actino- et des astéro-cyclines), mais pas une seule lépidocycline. Par contre, dans les milliers de plaques microscopiques de roches de Java et de Sumatra, qui d'après leurs mollusques doivent appartenir au terrain *tertiaire supérieur*, je n'ai rencontré que des lépidocyclines et jamais je n'y ai observé une seule discocycline." (*Op. cit.* p. 1164.)

So far as our observations go they tend to confirm this generalization of Dr. Verbeek. In the sections cut from the pebbles taken from the bed of the River Malinam we find associated with *Nummulites* a few vertical sections of *Orbitoides*. We have not been able to discover in our slides any sections showing the chambers of the median plane, but the general appearance of the sections leads us to look upon the *Orbitoides* as *Discocyclines* rather than *Lepidocyclines*. On the other hand, in our sections containing undoubted *Lepidocyclines* we find no trace of *Discocyclines*, and *Nummulites* are altogether absent, though we have met with one or two rather obscure sections of *Amphistegina*.

4. *Orbitoides (Lepidocyclina) Verbeeki*, sp. n.
(Pl. IX. figs. 7-11; Pl. X. fig. 1.)

Orbitoides papyracea, Brady, Geol. Mag. 1875, pl. xiv. fig. 1, p. 535 (non Boubée).

Lepidocyclina species *g* and *k*, Verbeek and Fennema, Descr. géol. de Java et Madoura, 1896, vol. i. pl. xi. figs. 173-175, 177-180, vol. ii. p. 1178.

In the volume of the 'Geological Magazine' referred to above the late Dr. Brady described and figured certain *Orbitoides* and other Foraminifera from Sumatra. The specimens were supplied by Dr. Verbeek, and they are now preserved partly in the British Museum (Nat. Hist.) and partly in the University Museum of Zoology at Cambridge. Certain of the *Orbitoides* were referred by Dr. Brady to *O. papyracea*, Boubée, and were so figured in the plate xiv. illustrating his paper. *O. papyracea*, Boubée, however, belongs to Gumbel's subgenus *Discocyclina*, having the chambers of the median plane rectangular; but Brady's Sumatran specimens have the chambers of the median plane

"en losange," as Dr. Verbeek has already pointed out merely from an examination of fig. 1c in Brady's plate; and they are therefore properly to be referred to the subgenus "*Lepidocyclina*," which is characterized by the possession of non-rectangular chambers in the median plane.

In order to clear up as far as may be the proper relationships of Brady's species we have carefully examined the numerous free specimens, now in the British Museum, which Dr. Brady had before him when writing his paper; and by the kindness of Dr. Harmer, of the University Museum of Zoology at Cambridge, we have been enabled thoroughly to examine the actual figured and other prepared specimens used by Brady to illustrate his paper.

We have no hesitation in saying that Brady's Sumatran specimens are identical with a species which occurs frequently in our slides cut from one of the pebbles taken from the bed of the River Malinam; and we agree with Dr. Verbeek that they are identical also with the species *g* and *k* figured in plate xi. of his work already several times referred to.

So far as we can see the specimens fall under no species already described—and here we are in agreement with Dr. Verbeek—and we therefore describe it as a new species under the designation *Orbitoides (Lepidocyclina) Verbeeki*. As the Sumatran specimens which we have been able to study are perfect, numerous, and quite free from matrix, we have preferred to figure for the most part preparations of those rather than our Borncean sections. Fig. 9 of Pl. IX., however, is from one of our slides.

Characters. The species is dimorphic—that is to say, some individuals have the initial chamber large, while in others it is very small, practically invisible. They are distinguished here as form A and form B respectively.

Form A.—Shell discoidal, regularly swollen at the centre; surface smooth and devoid of ornament; edge very slightly thickened and rounded; initial chamber large and apparently always succeeded by a chamber still larger and partly embracing the first; chambers of the median plane lozenge-shaped, the chamber-walls being slightly curved; chambers above and below the median plane irregular in shape, but somewhat regularly disposed. External dimensions of shell 5 to 6 millim. in width by 1.5 to 2 millim. in thickness; inside dimensions of the two central chambers taken together about .5 millim. in width by .25 millim. in depth; chambers of median plane very minute; long axis of lozenge about .09 millim.

The external appearance of a typical specimen is well

shown in fig. 1 of Pl. X. Fig. 7 of Pl. IX. shows the vertical section and fig. 8 the chambers of the median plane; while a horizontal section cutting the chambers above the median plane is given in fig. 10.

Form B.—Shell discoidal, regularly swollen at the centre; surface smooth and devoid of ornament; edge thin and more extended than in form A; initial chamber invisible; some specimens appear to show a spiral arrangement of the first few chambers; chambers of the median plane lozenge-shaped and similar in appearance and dimensions to the corresponding chambers of form A; chambers above and below the median plane also similar to those of form A. External dimensions of the shell 10 to 12 millim. in width by about 2 millim. in thickness; some individuals may considerably exceed in size the width here given, because the thin edge of the specimens we have examined is generally more or less broken. The chambers of the median plane of form B are shown in Pl. IX. fig. 11.

Occurrence. The specimens of *O. (Lepidocyclina) Verbeeki* in the British Museum and in the University Museum of Zoology at Cambridge were collected by Dr. Verbeek in Sumatra. Dr. Verbeek's species "*g*" came from the "Marne près d'Hilihoia, île de Nias, côte occidentale de Sumatra"; the species "*h*" was obtained from the "Calcaire de Boukit Ngareh ou Pouangang, à Batoumëndioulour, hauts plateaux de Padang, côte occidentale de Sumatra." Our Bornean specimens are from pebbles found in the bed of the River Malinam.

5. *Orbitoides (Lepidocyclina) sumatrensis*, Brady.
(Pl. X. figs. 7–12.)

Orbitoides sumatrensis, Brady, Geol. Mag. 1875, p. 536, pl. xiv. fig. 8; and Jaarb. Mij. Ned. Ooste-Indie, 1878, vol. vii. pt. 2, pl. ii. fig. 3, p. 165.

This species was first described by Brady in the paper on the Sumatran Foraminifera published in the Geol. Mag. as above. We reproduce here the material part of Brady's note:—"There are still some two or three little fossils pertaining to the genus *Orbitoides*. They are subglobular or only slightly compressed, 3 millim. in diameter and about 2·5 millim. in thickness. The exterior is rough and granular. Laid horizontally, there is an irregular partial extension of the periphery, which seems to suggest an abortive disc. It is within the bounds of possibility that these specimens may be the central thick portions of some form like the more umbonate varieties of *O. dispansa*, but the interior structure

does not lend itself to this supposition. The general arrangement of the chamberlets is shown in fig. 3 c, which is drawn from a horizontal section near, but not at, the median plane. A transverse section shows the median disc, which does not appear to be quite uniformly central in its position, exceedingly thin in the middle, thickening rapidly towards the circumference, rounded at the margin, and having somewhat the contour in section of an hourglass drawn out a little at the ends. The primordial chamber, as far as can be made out, is very small."

In our Pl. X. figs. 7 and 8 we figure again the specimens illustrated by Brady in the 'Geological Magazine.' Brady's figures were drawn by A. Hollick, ours are from photographs of the actual specimens, and simply demonstrate the accuracy of the original drawings. In fig. 10 we give Brady's preparation (not before figured) on which he appears to have based his description of the transverse section of the shell. It is clear that this figure does not represent a vertical section, but one taken at a considerable angle with the vertical.

An example of *O. sumatrensis* in the British Museum (Nat. Hist.) collection has been ground down in order to discover the true characters of the chambers of the median plane (Pl. X. fig. 9). In thus operating upon this specimen we were able to note the appearance of the horizontal sections at various stages and also sections at slight angles with the horizontal. We have thus been enabled to recognize that numerous orbitoid sections in our slides cut from the limestone of Gomanton Hill and from one of the pebbles from the bed of the River Malinam are to be properly referred to this species; and we venture to give the characters of the species as follows:—

Characters. Shell subglobular; about 3 millim. in width by 1.5 to 2.5 millim. in thickness; exterior rough and granular; median edge produced to form a narrow keel; median chambers variable in size and shape, but always rounded or "spatuliform." Chambers above and below the median plane have the shape of shallow cylinders and are remarkably constant in size and regular in arrangement; chamber-walls finely perforate. The initial chamber of the British Museum specimen was "megalospheric" (about .5 millim. in diameter); the Cambridge specimen (Pl. X. fig. 10) is possibly, as Brady supposed, "microspheric." If so, we have both form A and form B of the species.

The general external appearance of the shell is shown in Pl. X. fig. 7, photographed from Brady's figured specimen.

Fig. 8 is photographed from Brady's horizontal section cut "near, but not at, the median plane." It and fig. 10 show well the cylindrical shape of the chamberlets and the perforate chamber-walls. Fig. 6 shows the shape of the chambers of the median plane, and figs. 1 and 3 (from our Bornean material) give vertical sections of the shell.

Occurrence. Brady's specimens were collected by Dr. Verbeek from the marl-rock of Nias Island, west coast of Sumatra. Our specimens are from the Gomanton-Hill limestone and from pebbles taken from the bed of the River Malinam.

6. *Orbitoides (Discocyclina) stellata* (d'Archiac).
(Pl. X. fig. 2.)

Calcarina? stellata, d'Archiac, "Desc. Foss. Couches Nummulines environs Bayonne," Mém. Soc. Géol. France, 1846, sér. 2, vol. ii. pt. 1, pl. vii. fig. 1, p. 199.

Orbitoides (Asterocyclina) stellata, Gümbel, "Beitr. Foram. nordalpinen Eocäugebilde," Abhandl. k. Bayer. Akad. Wiss. 1868, Classe ii. Band x. p. 713, pl. ii. fig. 115, pl. iv. figs. 4-7.

To this species probably belongs the specimen figured in Pl. X. fig. 2. We have some hesitation in naming the specimen at all, and do so only because of its association in our slides with *Nummulites javanus* and because we find that, so far as our study of the Sumatran and Bornean material goes, Dr. Verbeek's generalization as to the non-occurrence of Lepidocycline *Orbitoides* in association with *Nummulites* appears to hold good.

Occurrence. In a pebble from the bed of the River Malinam.

7. Other *Orbitoides*.
(Pl. X. figs. 3 & 4.)

In our slides cut from pebbles of the River Malinam in which *Nummulites* occur there are a considerable number of sections (more or less vertical) of *Orbitoides*. They probably belong to the subgenus *Discocyclina*, and possibly include *O. (Discocyclina) papyracea*, Boubée, and *O. (Discocyclina) dispansa*, Sowerby. One of the vertical sections we figure in Pl. X. fig. 3.

In the material collected by Prof. Molengraaff one section, probably of a *Discocyclina*, has been met with; this we figure in Pl. X. fig. 4.

(C) LINDERINA*.

8. *Linderina*, sp. indet. (Pl. X. fig. 6.)

In our slides cut from the Gomanton-Hill limestone numerous sections of specimens of this interesting genus occur, but there are not a sufficient number of good sections to enable us to refer them specifically.

The characters of the genus, as given by M. Schlumberger, are as follows:—

“Plasmostracum discoïdal surépaissi au centre, composé d'un seul rang de nombreuses petites loges disposées circulairement autour d'une loge centrale et dans un même plan. Les parois de chaque série de loges se prolongent vers le milieu au-dessus des loges déjà formées. Cette enveloppe calcaire est traversée par de fortes perforations qui pénètrent directement jusqu'aux loges internes.”

One species only is known, namely *L. brugesi*, Schlumberger, which comes from the Upper Eocene of Bruges (Gironde).

(D) CYCLOCLYPEUS.

9. *Cycloclypeus*?, sp. indet. (Pl. X. fig. 5.)

The remarkable specimen figured as above is probably to be referred to this genus. It occurs in one of the pebbles from the bed of the River Malinam associated with *Nummulites javanus*, forms A and B. The actual shell was probably at least twice the width of the fragment preserved, and presumably had the shape of a thin disk with a central swelling and two or more concentric thickened bands. The published figure which appears to have the closest resemblance to it is that of *Cycloclypeus annulatus*, Martin (Tertiärsch. Java, 1879-80, p. 157, pl. xxviii. fig. 1).

(E) OTHER FORAMINIFERA.

10. *Miliolina*, *Spiroloculina*?, *Planispirina*, &c.

Our slides cut from the pebbles of the Malinam River and from the Gomanton-Hill limestone contain numberless sections of other Foraminifera belonging to the genera *Miliolina*,

* C. Schlumberger, “Note sur les Genres *Trillina* et *Linderina*,” Bull. Soc. Géol. France, 1893, sér. 3, vol. xxi. pl. iii. figs. 7-9, p. 120.

Spiroloculina?, *Planispirina*, and to the subfamily Rotalinæ; but we have not thought it worth while to attempt to refer such to particular "species," since we have nothing but sections cut in more or less indeterminate directions.

EXPLANATION OF THE PLATES.

PLATE IX.

Nummulites javanus, Verbeek. Form B.

- Fig. 1. Vertical section, $\times 3$. (B. M.)
 Fig. 2. Horizontal section, $\times 10$. (B. M.)
 Fig. 3. "Filets cloisonnaires," $\times 10$. (B. M.)

Nummulites javanus. Form A.

- Fig. 4. Vertical section, $\times 15$. (B. M.)
 Fig. 5. Ditto, $\times 10$. (B. M.)

Nummulites, sp. indet.

- Fig. 6. Vertical section, $\times 12$. (M.)

Orbitoides (Lepidocyclus) Verbeeki, sp. n. Form A.

- Fig. 7. Vertical section, $\times 13$. (C.)
 Fig. 8. Horizontal section on median plane, $\times 20$. (B. M.)
 Fig. 9. Ditto, $\times 30$. (B. M.)
 Fig. 10. Horizontal section above median plane, $\times 13$. (C.)

Orbitoides (Lepidocyclus) Verbeeki. Form B.

- Fig. 11. Horizontal section on median plane, $\times 25$. (B. M.)

PLATE X.

Orbitoides (Lepidocyclus) Verbeeki. Form A.

- Fig. 1. Exterior, $\times 9$. (C.)

Orbitoides (Discocyclus) stellata, d'Archiac.

- Fig. 2. Section approximately horizontal and above median plane, $\times 20$. (B. M.)

Orbitoides (Discocyclus), spp. indet.

- Fig. 3. Vertical section, $\times 12$. (B. M.)
 Fig. 4. Ditto, $\times 25$. (M.)

Cyclolypeus?, sp. indet.

- Fig. 5. Section, $\times 11$. (B. M.)

Linderina, sp. indet.

- Fig. 6. Vertical section, $\times 30$. (B. M.)

Orbitoides (Lepidocyclus) sumatrensis, Brady.*Fig.* 7. Exterior, $\times 9$. (C.)*Fig.* 8. Horizontal section above median plane, $\times 30$. (C.)*Fig.* 9. Chambers of median plane, $\times 60$. (B. M.)*Fig.* 10. Oblique section, $\times 35$. (C.)*Fig.* 11. Vertical section, $\times 16$. (B. M.)*Fig.* 12. Ditto, $\times 25$. (B. M.)

Note.—The capital letters within brackets have the following signification:—

B. M. = British Museum collection.

M. = Professor Molengraaff's collection.

C. = Cambridge Museum of Zoology collection.

XLI.—*The Outcome of a South-Sea Voyage* *.

By L. A. BORRADAILE.

DR. ARTHUR WILLEY was engaged on a voyage of research in the South Seas from 1895 to 1897. Since his return his valuable material has been in the hands of specialists, and the results of their labours are to be embodied in a work at present appearing in parts from the Cambridge University Press. The first two of these parts are now before us.

It is quite clear that, however valuable be the papers by other contributors, the explorer's own communications will form the prominent feature of the series.

This is amply evident in the first number, in which by far the most important article is the opening one by Dr. Willey on a new species and subgenus of *Peripatus* from New Britain. In accordance with the territorial nomenclature adopted for many species of the genus, the new form is to be called *Peripatus (Paraperipatus) novæ-britanniæ*. The male of this creature has 22 pairs of legs and the female, which is larger and more numerous, has 24. There are three spinous pads on each leg, and the generative opening is placed immediately behind the last pair. Receptacula seminis are present in the female, but there are no receptacula ovarum. The eggs are small and without yolk. The accessory glands of the male open to the exterior through a median bulbus immediately above the anus. The ductus ejaculatorius is median and short, and spermatophores are not formed.

* 'Zoological Results, based on material from New Britain, New Guinea, Loyalty Islands, and elsewhere, collected during the Years 1895, 1896, and 1897.' By Arthur Willey, D.Sc. Lond., Hon. M.A. Cantab., Balfour Student of the University of Cambridge. Parts I. and II. Cambridge: at the University Press. 1898.

Of the several interesting points arising in the course of the anatomical description the first occurs in the paragraphs on the female generative organs. The ovarian wall is thin and differs in structure from that of the oviduct, showing in this point a resemblance to the Cape and Australasian species and differing from the Neotropical. The eggs are follicular. Immediately on leaving the ovary the oviduct is of a structure different from that which it assumes during the rest of its length, and this first portion of the oviduct is called by Dr. Willey the "infundibulum," and likened to the funnel of a nephridium. The ovary itself is compared with the end-sac. Unfortunately there are no observations on the development of these organs.

The male generative organs, however, present features of even greater interest than the female. The vasa deferentia are symmetrical and pass to the exterior by a median ductus ejaculatorius which is hardly larger than the vagina of the female. This arrangement is precisely that supposed by Moseley to have been the original condition of the parts in question. The arrangement of the accessory glands is different from that presented by either of the other subgenera—in fact, each section of the genus has these organs in a condition quite different from that found in any of the others. Dr. Willey suggests that they are capable of throwing light on the Malpighian tubules of insects.

But the crowning peculiarity of the New-Britain *Peripatus* lies in the structure of its embryos. Of these a fairly complete series was available for examination, owing to the fact that each fertilized female contains a number of young of various ages. In the following short account of their development it will be best to use the author's own words where this is possible. In the early stages "the embryonic area proper is confined to a thickened tract at the posterior-ventral side of a large oval vesicle. The rest of the wall of the vesicle is composed of embryonic ectoderm and endoderm, which take no immediate part in the formation of the embryo. Physiologically it corresponds exactly with the peripheral epiblast and hypoblast of a mammalian blastodermic vesicle. As in the latter, it is the ectoderm which is chiefly concerned in the absorption of nutriment for the use of the embryo, as evidenced by the vacuolar character of the cells." In a later stage the vesicle comes to project behind as well as in front of the embryo.

By the appearance of a deepening transverse groove in the embryonic area the embryo proper becomes U-shaped. In the course of subsequent growth it becomes spirally coiled.

"The anterior region of the embryo is practically a punctum fixum, and the contortion of the embryo in a later stage is almost entirely due to the growth which is taking place at the primitive streak"—the latter being at the hind end.

The endoderm has a chequered history. In one of the earlier stages "many endoderm-cells forsake their epithelial position and become converted into wandering trophocytes." Subsequently the endoderm reconstitutes itself and forms "a fairly compact epithelial layer containing numerous eosinophile granules of varying sizes." Later on still this endoderm again breaks up. "In young individuals the brightly staining globules have entirely disappeared. The endoderm does not form an epithelial layer, but consists of cells lying loosely and freely in the gastral cavity, like the trophocytes in the embryo." A reconstitution of the endoderm after this second histolysis has not been observed. It is suggested that histolysis of the endoderm is a periodically recurring phenomenon in *Peripatus*.

As to the general bearings of this history, the resemblance of the embryo in the earlier stages to that of an insect before the infolding, and of the trophic vesicle, "when the embryo is flexed and the trophic organ covers its ventral surface as with a cap," to the amnion of an insect is duly pointed out in the present paper, and has since been the subject of an article in the 'Quarterly Journal of Microscopical Science.' But there is another resemblance, even more interesting if less obvious than that just referred to, on which Dr. Willey is at present silent.

The discovery of a new method of development in *Peripatus* naturally suggests speculation as to whether the embryo is in any way comparable with the trochosphere larva of Annelids. Now the embryo in question is a vesicular creature, with a greatly swollen preoral region, a ventral mouth-site, and two ventio-lateral bands of mesoderm (hindward these two bands become one), starting at the hind end in the neighbourhood of the future anus, and thence proliferating. The adult form is reached by the elongation of the hinder part of the body concurrently with the formation of new segments at the hind end and the reduction of the antero-dorsal vesicular region. In all these points our embryo resembles a trochosphere. The absence of the ciliated rings would, of course, be expected in view of the loss of the free life. No serious difficulty is presented by the absence of a blastocœl, this condition being already known in various Polychætes (*Psugmobranchus* &c.) and in the Earthworms. The embryos of the latter group, under the influence of altered conditions of nutrition, show a

curious analogy with that of our *Peripatus*, although the nutritive conditions in the present case have been altered in a somewhat different direction, and the ectoderm is required to be absorptive, and not merely retaining as in the earthworms. Indeed, it seems scarcely extravagant to hope that renewed investigation may reveal traces of some structure comparable to the trochosphere head-kidney. Further details will in any case be awaited with interest.

So much for the resemblance of the new *Peripatus* embryo to the trochosphere. It must at the same time be confessed that the presence of a primitive streak points to the probability that the original free larva of *Peripatus*, postulated by Kennel and Willey, was not in all respects a typical trochosphere. But it seems not unlikely that this very feature may lead to the most valuable results when the whole question is fully discussed.

The other articles in Part I. are:—one by Dr. Paul Mayer on a new Caprellid, to which he has given the name of *Metaprotella sandalensis*, and which is interesting on account of its habitat, Caprellids being rare in the tropics; one by Mr. G. A. Boulenger on the rare sea-snake *Aipysurus annulatus* (Kreff); two by Mr. R. I. Pocock on the Arachnids and Myriapods respectively; and one by Dr. David Sharp on the Phasmidæ, with notes on the eggs. The introduction to the latter article contains some very interesting remarks on the eggs of Phasmidæ and other subjects relating to the same family.

With the exception of a valuable little paper by Mr. J. Stanley Gardiner on the postembryonic development of the Fungid coral *Cycloseris*, which he finds to closely resemble that of *Fungia*, the whole of the second part is given up to systematic accounts of the collections of various groups of animals. It includes a paper on the Milleporidæ by Professor Hickson, containing some interesting remarks on retractile nematocysts in that group; and reports on the Holothurians by Mr. F. P. Bedford, on the other Echinoderms by Prof. Jeffrey Bell, on Sipunculids by Mr. A. E. Shipley, on Solitary Corals by Mr. J. Stanley Gardiner, on Earthworms by Mr. F. E. Beddard, and on Gorgonacea by Miss I. L. Hiles.

For the rest, the style in which this publication is produced is above praise. The type is large and clear, and set in fair wide margins; the plates are excellent, and accompanied, where this is needed, by full and clear explanations. A good setting for good work.

BIBLIOGRAPHICAL NOTICE.

Catalogue of the Lepidoptera Phalaenæ in the British Museum. Volume I. (pp. xxi & 559) and Plates (i.-xvii.). *Catalogue of the Syntomidæ in the Collection of the British Museum.* By Sir GEORGE F. HAMPSON, Bart. London: printed by order of the Trustees. 1898. 8vo.

THE Trustees of the British Museum are to be congratulated on their boldness in resolving to attempt a monumental work in entomology, on the Moths of the world—a group which, though very incompletely known or collected at present, probably numbers at least five or six times as many species as the whole of the Birds, the Museum Catalogue of which has just been completed in twenty-seven thick octavo volumes, exclusive of Supplement and Index. The Bird Catalogue is the work of eleven different authors, and the effort to describe a far larger group may well be beyond the powers of one entomologist; but Sir George Hampson is a young and energetic man, and, what is of even far greater importance, it is evident that he has very wisely been given a perfectly free hand, and every encouragement by the authorities of the Museum. Consequently he commences his arduous task under the most favourable auspices, and great things may be expected of him.

The plan of the work is similar in the main to the author's useful 'Moths of India,' from which many of the illustrations, especially those in the Introduction, are copied; but in one respect we notice a change for the better. The author is well known to be what is called, in entomological slang, "a lumpner"; and in some cases many nominal species are sunk under one. In the present work an attempt has been made to show which names are regarded as absolute synonyms, and which represent actual variations of greater or less importance; and although we think this should have been done more fully, yet this feature marks a decided improvement on the 'Moths of India,' in which very few indications of this kind were given.

The Introduction to the present work commences with general information respecting Lepidoptera; and it is very convenient in a work of this kind to have careful diagrams of such features as wing-venuration always available for ready reference. We should almost be inclined to recommend that such diagrams should be reproduced in each volume.

Then follow remarks on the phylogeny of Lepidoptera, illustrated by tables, but expressed, as is frequently the case with writers who attempt to trace out schemes of evolution, which must, after all, be largely tentative and conjectural, in rather too dogmatic a manner for our taste.

In Geographical Distribution the author admits four principal zones, viz.:—Northern Temperate, the Tropical Zone of the Old World, the Neotropical, and, finally, the Australian Region.

A brief sketch is then given of the general scheme of the work, followed by a key to the families of Lepidoptera, of which the author now admits 52, 7 of which include butterflies; and these, though placed at the head of the table, are numbered from 33 to 39, their place being thus indicated between the Castniadæ and the Euschemonidæ, an arrangement which will probably not be accepted by all entomologists. As the plan of the work is to begin with the most highly organized families and to work downwards, the present volume is devoted to the Syntomidæ, which the author now places as Fam. 1. This group was formerly regarded as a section of the Zygænidæ, between the true Zygænidæ and the Arctiadæ, which here form Fam. 2; but the Zygænidæ are now removed to a great distance, standing as Fam. 41. Then follow general observations on the Syntomidæ, a key to the genera, and a table showing their comparative affinities, and then the author plunges *in medias res*.

Before speaking of the work itself we may mention that it is introduced by a conventional preface by Sir William Flower, followed by a Systematic Index, the value of which would, however, we think, have been much increased for purposes of ready reference if the names of the authors had been appended to the species and genera, an improvement which we hope to see adopted in future volumes. There is also a general Alphabetical Index at the end of the book.

1184 species are described in the present volume, including many which are not in the British Museum, but of which authentic specimens have been examined by the author. It has wisely been decided, however, that no new species are to be described in the work, except those of which the British Museum actually possesses the types.

The descriptions are short, but will probably be sufficient for the identification of the species, especially as a large number are figured. We may, however, express a hope that too great uniformity of plan may not lead to too mechanical a method of work—an error into which all naturalists are liable to fall when they are required to describe a large number of species.

As the identification of species is one of the principal objects in a work of this description, it would be unfair to expect that much space could be given to metamorphoses or other detailed information. What a fairly complete account of individual species would really imply, entomologists will soon have an opportunity of learning from Mr. Tutt's forthcoming work on the British Zygænidæ—though even Mr. Tutt, so far as we know, deals chiefly, if not exclusively, only with synonymy, external characters and variation, range, habits, localities, metamorphoses, and food. A series of volumes would be required to contain all the attainable information relating to *almost any single species* of animal or plant, as every naturalist must be well aware.

The determination of species is much facilitated in the present work by elaborate tables, which are specially useful in the case of the larger genera, and by the numerous illustrations. Each genus,

and each of the more important sections of a genus at least, are illustrated in the text, while all species that have not been satisfactorily figured elsewhere, are, as far as possible, to be represented on the coloured plates. These are issued and sold separately—a great advantage for working entomologists, who frequently require more than one copy of a work of this description; and it would be too much to expect them to buy a duplicate set of coloured plates too. We regret that both the plain and coloured figures represent one side of the insect only; but this inartistic method was absolutely unavoidable without a very large (and, for scientific purposes, unnecessary) additional outlay of both space and money.

We hope Sir George Hampson may live to bring out many more volumes similar to the book now before us.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 9th, 1898.—W. Whitaker, B.A., F.R.S.,
President, in the Chair.

The following communication was read:—

‘On the Radiolaria in the Devonian Rocks of New South Wales.’
By G. J. Hinde, Ph.D., F.R.S., F.G.S.

Hand-specimens of the various radiolarian rocks discovered by Messrs. David and Pittman in New South Wales were forwarded to the Author, and from them numerous microscopic sections were prepared. In the chert and jasper rocks of the Jenolan, Bingara, and Tamworth districts, the radiolaria were for the most part in the condition of casts filled with chalcedonic silica and without structure, so that their generic characters could not be determined. Also in the claystones, the radiolaria were but poorly shown in sections, though the structure could be seen in specimens weathered out naturally on the surface of the rock. But in the siliceous limestones and in the volcanic tuffs the radiolaria were embedded in, and infiltrated with calcite, and by careful etching of thin sections of the rock, the lime was eliminated and the organisms were shown very distinctly. The rock then appeared as a confused mass of entire and fragmentary radiolaria and minute débris of their spines and latticed tests. The silica of these forms is for the most part still in its colloid condition; in some, however, it has been replaced by a dark mineral.

Fifty-four species belonging to 29 genera have been determined and figured; all the species and four genera are regarded as new; excepting a few primitive types of Nassellaria, the forms belong to the Spumellaria. The large majority may be included in the

Sphæroidea and Prunoidea with medullary tests and radial spines. They do not show any near relationship to the radiolaria described from Devonian rocks in Europe, but in some features they resemble the radiolarian faunas of Ordovician age in the South of Scotland, Cornwall, and Cabrières, Languedoc.

No other fossils beyond a few simple sponge-spicules and, on two or three horizons, some fragmentary impressions of *Lepidodendron australe*, have been found in association with the radiolaria.

These New South Wales radiolarian deposits are by far the most extensive of any hitherto known, and they are remarkable not only for their great thickness but also for the manner in which the radiolaria are preserved in the limestones, tuffs, and claystones.

November 23rd, 1893.—W. Whitaker, B.A., F.R.S.,
President, in the Chair.

The following communication was read:—

‘On the Remains of *Amia* from Oligocene Strata in the Isle of Wight.’ By E. T. Newton, Esq., F.R.S., F.G.S.

The specimens described in this communication were found by Mr. Clement Reid in the Bembridge Marls of Hamstead, and by Mr. Colenutt in the Bembridge Beds and in the Osborne Series of King’s Quay, near Ryde. After a reference to species described in America and referred to the genera *Amia*, *Protomiu*, *Hypamia*, and *Pappichthys*, the Author proceeds to the description of the specimens in question, referring them all to the genus *Amia*. The specimens include the following bones:—vertebræ, maxillæ with the supplementary bones, premaxillæ, bones of the skull, dentary bones, a parasphenoid, a clavicle, scales, and teeth. They are referred to two new species of the genus *Amia*. The paper concludes with a table of all the species hitherto recorded from America and Europe.

December 21st, 1893.—W. Whitaker, B.A., F.R.S.,
President, in the Chair.

The following communication was read:—

‘On a Megalosauroid Jaw from Rhætic Beds near Bridgend, Glamorgan-shire.’ By E. T. Newton, Esq., F.R.S., F.G.S. (Communicated by permission of the Director-General of H.M. Geological Survey.)

The specimen which forms the subject of the present communication was obtained by Mr. John David of Porthcawl, from a mason, and it has been presented to the Museum of Practical Geology. It was derived from beds low down in the Rhætic Series, which may eventually have to be included in the upper part of the Keuper. The lamellibranchs on the same slab appear to be *Pullustru arenicol*.

and possibly *Myophoria*. The specimen has been compared with reptilian jaws in the British Museum: it consists of a mould of the dentary bone with several teeth in place. The impression of the whole of the inner surface, and of the anterior half of the outer surface, is preserved. The front half of the inner surface of the jaw is like that of *Megalosaurus*, except in size. Many of the teeth are seen in various stages of projection from their sockets, and the points of two successional teeth may also be seen, and thus the mode of succession of the teeth may be clearly understood. The specimen does not admit of exact comparison with *Megalosaurus*, and it is named as a new species of *Zanclodon*—a genus in which the Author is also inclined to place some forms described under the names of *Palæosaurus*, *Cladyodon*, *Avalonia*, and *Picrodon*.

MISCELLANEOUS.

Lichtenstein's 'Catalogus rerum naturalium.'

To the Editors of the 'Annals and Magazine of Natural History.'

GENTLEMEN,—Lichtenstein's 'Catalogus,' 1793-96 (3 parts), is so rare that only two copies are known to exist, one in the British Museum and one in the University of Kiel. Mr. DuCane Godman reprinted part 1 (Mammalia and Birds) for the Willughby Society in 1882, but he did not then know the name of the owner of the collection catalogued. In working through the Banksian Tracts I have come across 'Catalogus Musei Zoologici ditissimi Hamburgi, d. 16 Majus, 1797, Scetio Tertia continens Insecta.' The close similarity of the title and of the printing of the tract, and the fact that the specific names were familiar, recalled to my memory the 'Catalogus rerum.' On comparing the two I found them identical, except that in the 1797 tract many species that appeared in the 'Catalogus rerum' were missing. The 1797 tract was therefore obviously by Lichtenstein, and a reference to Hagen (Bibl. Entom. 1862, p. 477) showed that he had seen part 3 of the 'Catalogus rerum,' but catalogued it under its subtitle, and so lost its identity. Furthermore, Hagen notes that it was a catalogue of the "Museum Holthuisen" (cf. Engelmann, Bibl. Hist. Nat. 1846, p. 488). It therefore appears that the 1797 Catalogue was a reprint of the 'Catalogus rerum' with the "sold" items struck out, and that the original sale of the Museum Holthuisen being in part a failure, the collection was again put up for sale in the following year.

C. DAVIES SHERBORN
(*'Index animalium'*).

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 16. APRIL 1899.

XLII.—*Descriptions of new Batrachians in the Collection of the British Museum (Natural History).* By G. A. BOULENGER, F.R.S.

[Plates XI. & XII.]

Rana lurutensis. (Pl. XI. figs. 1, 1 a.)

Vomerine teeth in two very small groups just behind the level of the choanæ. Head as long as broad; snout shorter than the diameter of the orbit, rounded or subacuminate, projecting; canthus rostralis sharp; loreal region concave; nostril equally distant from the eye and the tip of the snout; interorbital space narrower than the upper eyelid; eye large; tympanum distinct, one third the diameter of the eye. Fingers moderate, the ends dilated into large disks, which are larger than the tympanum; first finger shorter than second, third as long as the distance between the anterior border of the eye and the tympanum. Toes very broadly webbed, the web involving part of the terminal disks, which are smaller than those of the fingers; subarticular tubercles feeble; a small, feebly prominent, oval inner metatarsal tubercle. The tibio-tarsal articulation reaches beyond the tip of the snout; tibia three fifths to two thirds the length of head and body. Skin smooth or faintly granular; a feeble interrupted dorso-lateral glandular fold. Dark olive above, with irregular darker

and lighter blotches; a dark canthal streak; limbs with regular dark cross-bars; hinder side of thighs marbled black and white; lower parts white.

From snout to vent 54 millim.

Three specimens from Larut, Perak, 3000 feet. Presented by Mr. Stanley S. Flower.

Nearest allied to *R. latopalmata*, Blgr., and connecting this species with *R. chalconotus*, Schleg.

Rappia phantastica. (Pl. XI. fig. 2.)

Snout rounded, as long as the diameter of the orbit; loreal region nearly vertical; nostril near the end of the snout; tympanum distinct, hardly half the diameter of the eye. Outer fingers half-webbed; toes entirely webbed. The tibio-tarsal articulation reaches between the eye and the tip of the snout; tibia half length of head and body. Skin smooth, except on the belly, which is coarsely granulate; no strong fold across the chest. Sides and upper surface of head, back, upper surface of fore limb, tibia, and tarsus bright red; sides of back, a zone separating the head from the back, upper surface of thigh, and lower parts lemon yellow; a canthal streak, sides of belly, sides and part of lower surface of thighs, hands and feet ink-black.

From snout to vent 35 millim.

A single specimen (♀) from the Benito River, French Congo. Collected by Mr. G. L. Bates.

Nearest allied to *R. Steindachneri*, Bocage.

Phyllobates Pratti. (Pl. XI. fig. 3.)

Snout rounded, moderately prominent, not quite so long as the diameter of the orbit; loreal region vertical; nostril a little nearer the tip of the snout than the eye; interorbital space broader than the upper eyelid; tympanum rather indistinct, hardly half the diameter of the eye. Fingers moderate, first extending slightly beyond second; toes moderate, free; disks well developed, smaller than the tympanum; two small metatarsal tubercles, inner oval, outer rounded; a small oblique tubercle or ridge in the middle of the inner side of the tarsus. The tibio-tarsal articulation reaches the eye. Skin smooth, finely shagreened on the back. Brown above; a black streak from eye to eye round the snout; upper lip white; a broad black lateral stripe and a white streak in front of the insertion of the thigh; limbs pale, with a dark

brown streak on the thigh and some dark brown bars on the leg and foot; lower parts white.

From snout to vent 20 millim.

Two specimens from Santa Ines, N. of Medellin, Republic of Colombia; altitude 3800 feet. Collected by Mr. A. E. Pratt.

Dendrobates opisthomelas. (Pl. XI. fig. 4.)

Head a little longer than broad; snout rounded, feebly prominent, shorter than the diameter of the orbit; loreal region vertical; nostril equally distant from the eye and the tip of the snout; interorbital space as broad as the upper eyelid; tympanum distinct, about half the diameter of the eye. Fingers moderate, first not extending so far as second; disks of fingers and toes small, much smaller than the tympanum; two very feebly prominent small metatarsal tubercles, and a very indistinct tubercle on the middle of the inner side of the tarsus. Back covered with small flat warts. Head and body lemon-yellow above, obscured with dark brown or blackish on the coccygeal region, black round the vent; arms yellow, forearms, hands, and hind limbs blackish; throat and belly black, with white spots.

From snout to vent 20 millim.

Several specimens from Santa Ines, N. of Medellin, Republic of Colombia, altitude 3800 feet. Obtained by Mr. A. E. Pratt under rotten wood, together with the types of the preceding species.

Microhyla leucostigma. (Pl. XII. fig. 1.)

Habit moderately slender. Snout rounded, shorter than the diameter of the orbit; interorbital space broader than the upper eyelid. Fingers rather short, first much shorter than second; toes moderate, with a slight rudiment of web; tips of fingers and toes dilated into small but very distinct disks; subarticular and inner metatarsal tubercles flat, very feebly prominent. Tibio-tarsal articulation reaching between the eye and the tip of the snout. Skin smooth. Blackish brown above, dotted all over with white; limbs dark brown, with black cross-bars; lower parts with large yellowish-white spots separated by a blackish-brown network.

From snout to vent 25 millim.

Two specimens from Larut, Perak, 3000 feet. Presented by Mr. S. S. Flower.

Nearest allied to *M. inornata*, Blgr.


Bufo gracilipes. (Pl. XII. fig. 2.)

Crown without bony ridges. Snout obtusely pointed, truncate; interorbital space broader than the upper eyelid; tympanum very distinct, two thirds the diameter of the eye. Fingers slender, first extending considerably beyond second; toes slender, with a mere rudiment of web; subarticular tubercles single; metatarsal tubercles small, feebly prominent; no tarsal fold. The tibio-tarsal articulation reaches the tympanum, the tarso-metatarsal the tip of the snout. Skin rough with small conical warts; parotoids very small, flat, very indistinct. Dark brown above, marbled with reddish, whitish beneath.

From snout to vent 37 millim.

A single specimen from the Benito River, French.
Collected by Mr. G. L. Bates.

Hyla picturata. (Pl. XII. figs. 3, 3 a.)

Tongue circular, entire, nearly entirely adherent. Vomerine teeth in two strong angular series, forming a  between the very large choanæ. Head large, much depressed, a little broader than long; snout as long as the diameter of the orbit, rounded, slightly prominent at the end; canthus rostralis indistinct; loreal region very oblique, slightly concave; nostril near the tip of the snout; interorbital space as broad as the upper eyelid; tympanum distinct, not quite half the diameter of the eye. Limbs slender. Outer fingers one-third webbed; disks as large as the tympanum; no distinct rudiment of pollex. Toes three-fourths webbed. The tibio-tarsal articulation reaches a little beyond the tip of the snout; tibia three fifths the length of the head and body. Skin smooth; belly and lower surface of thighs feebly granulate; no dermal appendages. Violet above, with cream-coloured spots edged with purplish red; these spots arranged in groups with great symmetry, one on the head and nape, another in front of the sacrum, and a third on the coccygeal region; a white transverse band, interrupted in the middle, between the eyes; lores and temples whitish, with reddish markings; limbs creamy white above, with violet cross-bars alternating with narrower purplish-red ones; humerus and concealed surfaces of the hind limbs colourless; lower parts white.

From snout to vent 59 millim.

A single female specimen from Paramba, N.W. Ecuador.
Nearest allied to *H. crepitans*, Wied.

Hyla ocellifera. (Pl. XII. fig. 4.)

Tongue circular, entire, slightly free behind. Vomerine teeth in two round groups close together between the choanæ. Head much depressed, broader than long; snout rounded, shorter than the diameter of the orbit; canthus rostralis indistinct; loreal region very oblique, slightly concave; nostril nearer the tip of the snout than the eye; eye very large and prominent; upper eyelid rather narrow, narrower than the interorbital space; tympanum distinct, hardly one third the diameter of the eye. Outer fingers broadly webbed, the web reaching the penultimate joint of the third finger and the disk of the fourth; toes nearly entirely webbed; disks a little larger than the tympanum. The tibio-tarsal articulation reaches the tip of the snout; tibia half the length of head and body. Skin smooth, areolate on the belly and under the thighs. Bluish grey above, dotted with black; one or two small white black-edged ocelli on each scapular region; thigh colourless, except a very narrow streak of bluish grey along its upper surface; arms, hands, and feet colourless; lower parts white.

From snout to vent 28 millim.

A single specimen from Paramba, N.W. Ecuador.

Apparently nearest allied to *H. sordida*, Ptrs.

I avail myself of this opportunity to change the name *Hyla microcephala*, Blgr. (P. Z. S. 1898, p. 481) *nec* Cope (Proc. Amer. Phil. Soc. xxiii. 1886, p. 281), to *H. Underwoodi*.

EXPLANATION OF THE PLATES.

PLATE XI.

- Fig. 1. Rana larutensis*, p. 273.
Fig. 1 a. Ditto. Open mouth.
Fig. 2. Rappia phantastica, p. 274.
Fig. 3. Phyllobates Pratti, p. 274.
Fig. 4. Dendrobates opisthomelas, p. 275.

PLATE XII.

- Fig. 1. Microhyla leucostigma*, p. 275.
Fig. 2. Bufo gracilipes, p. 276.
Fig. 3. Hyla picturata, p. 276.
Fig. 3 a. Ditto. Open mouth.
Fig. 4. Hyla ocellifera, p. 277.

XLIII.—*Natural History Notes from H.M. Royal Indian Marine Survey Ship 'Investigator,' Commander T. H. Heming, R.N., commanding.* — Series III., No. 2. *An Account of the Deep-sea Crustacea dredged during the Surveying-season of 1897-98.* By A. ALCOCK, Major, Indian Medical Service, Superintendent of the Indian Museum, and A. R. S. ANDERSON, Captain, Indian Medical Service, Surgeon-Naturalist to the Survey.

[Continued from p. 27.]

MACRURA.

Family Penæidæ.

PENÆUS, Fabr.

Penæus rectacutus, Sp. Bate.

Penæus rectacutus, Sp. Bate, 'Challenger' Macrura, p. 266, pl. xxvi fig. 2 (exc. 2 s).

Metapenæus rectacutus, Wood-Mason & Alcock, Ann. & Mag. Nat. Hist., Oct. 1891, pp. 274, 275.

Spence Bate suggests that *Penæus serratus* and *Penæus rectacutus* may prove to be the same species. The former, of which there are two 'Challenger' specimens from Fiji in the Indian Museum, possesses no epipodite on the twelfth segment, while the latter has one.

In the males of this species the outer branch of the antennular flagellum is about twice the length of the inner and has a very stout base suddenly narrowing and tapering into a long filamentous extremity; from about the middle of the lower and inner side of this thickened base a small sharp conical tooth, as in *Metapenæus coniger*, projects; the inner branch is horizontally flattened in the proximal quarter of its length, and here forms a rigid semicircular loop downwards below the outer branch, as in *Penæus serratus*; on again reaching the level of the outer branch it gives off a small flattened hooked process articulating with the conical tooth on the outer branch, and becoming twisted on itself, and so vertically flattened lies alongside and in close apposition to the outer branch. Towards its extremity the inner branch becomes thin and filiform like the outer.

The absence of a rudimentary anterior arthrobranchia from the thirteenth segment seems to exclude this species from Wood-Mason's genus *Metapenæus*.

4 ♂, 3 ♀, from Station 235, 370-419 fathoms.

PARAPENÆUS, S. I. Smith.

Parapenæus investigatoris, sp. n.

Allied to *Parapenæus fissurus*, Sp. Bate, having the same branchial formula as we described for that species in Journ. Asiat. Soc. Bengal, vol. lxiii. pt. ii. 1894, p. 144 (from which, by a copyist's error, the epipodite on appendage 8 was omitted); the same longitudinal and vertical fissures in the carapace; a similar dorsal carina, bearing a single sharp tooth on the gastric region, and produced into a rostrum ciliated inferiorly, furnished with six teeth superiorly; a similar compressed abdomen, with the carina of the fourth, fifth, and sixth segments ending in a small tooth covering a small V-shaped notch in the posterior dorsal margin of the fourth and fifth segments; and a very similar telson and swimmeret.

It can at once be distinguished from *Parapenæus fissurus*, of which there are two 'Challenger' specimens from Zebu in the Indian Museum, by the presence of a well-marked sharp branchiostegal tooth placed slightly behind the anterior margin of the carapace, and not on it as in Spence Bate's species. It further differs in the length of the rostrum, which reaches only just beyond the end of the first joint of the antennular peduncle instead of beyond the end of the second joint; in the rostrum sloping gently upwards in its proximal, gently downwards in its distal half; in the relative shortness of the carapace, which, exclusive of the rostrum, is only very little more than $\frac{1}{3}$ the length of the abdomen instead of nearly $\frac{1}{2}$ the length; in the great relative length of the sixth abdominal segment, which is $2\frac{1}{2}$ times the length of the fifth segment instead of about $1\frac{1}{2}$ times its length; in the third abdominal segment being non-carinate; in the inner plate of the swimmeret extending for about $\frac{1}{4}$ its length beyond the extremity of the telson; in the inner branch of the antennular flagellum being slightly the longer, nearly as long as the carapace exclusive of the rostrum, and gradually expanding at its base, while the outer branch expands suddenly into a base considerably thicker than that of the inner branch; in the "thelycum" being of a different structure; and in never appearing to grow to the same size as *Penæus fissurus*.

5 ♀, 2 ♂, from Station 233, 185 fathoms.

3 ♀, 6 ♂, from Station 235, 370–419 fathoms.

2 ♀, 1 ♂, from Station 166, 133 fathoms.

HALIPORUS, Spence Bate.

Haliporus taprobanensis, sp. n.

This species appears to be nearly allied to *Haliporus thetis*, Faxon. The carapace is leathery, with deep cervical and longitudinal grooves. The dorsal carina is thrice interrupted in its course—by the cervical groove, by a broad shallow groove about midway between the cervical groove and the posterior margin of the carapace, and again close to the hinder margin of the carapace. Here the carina ends as a small tubercle separated from the posterior margin by the dorsal extremity of the longitudinal groove; in front of the cervical groove the carina is very prominent, armed with four teeth, and produced into a short slightly upraised rostrum, fringed below with long hairs. The rostrum, which appears to have been broken and imperfectly repaired, reaches just beyond the end of the cornea, ends in a sharp straight point, and is armed above with two small teeth near its base; succeeding these is a pair of minute teeth at the same level, one on each side of the rostrum, and beyond these a couple of sinuosities.

The first antennal tooth is separated from the tooth behind it by a groove running obliquely downwards and backwards from the level of the eye-stalk. On the posterior margin of the cervical groove is a well-marked sharp tooth, continued posteriorly into an elevated rounded ridge, running backwards parallel to and at a little distance from the longitudinal groove. The branchiostegal tooth, situated at the lower end of the frontal margin, is not so minute as in *Haliporus thetis*, and is continued backwards as an elevated ridge to the posterior margin of the carapace.

The abdomen is compressed and throughout carinate dorsally. The first, second, and third segments are marked by a deep transverse groove separating an anterior smooth articular from a posterior part of each segment. In the first segment the articular portion is nearly as long as the part behind the groove, the posterior half alone of which is elevated into a carina. In the second and third segments the articular portion forms only about $\frac{1}{4}$ of the total length of the segment, and the entire part behind the groove is carinate. The fourth, fifth, and sixth segments are carinate throughout their entire length. The carina is grooved in its centre and produced into a small sharp tooth at the posterior extremities of the fourth, fifth, and sixth segments; the posterior dorsal central margin of the second, third, fourth, and fifth segments is slightly notched V-wise. The transverse grooves on the

first to third abdominal segments are continued down on the pleuræ of these segments; furthest down and most marked on the first, the shortest distance and least marked on the third. The first to fifth segments are also furrowed by a transverse groove in their posterior quarter running nearly parallel to the hinder edge of each tergum, but bending obliquely forward and downward on reaching the pleuræ, where they fade away before attaining the margin. The fifth and sixth segments have an elevated horizontal ridge at the union of the pleuræ and terga, and the sixth possesses in addition an elevated ridge passing obliquely upwards and backwards from its articulation with the fifth segment to its posterior margin. The sixth segment is very slightly longer than the fifth. The telson lacks its extremity; dorsally it is widely grooved and on each side of the groove is an elevated ridge ending posteriorly in a short sharp spine. From these ridges the sides slope down obliquely, bear three minute spinules on either side, and have their lower margins fringed with hair.

The swimmeret is similar to that of *Haliporus thetis*, only differing in the sculpturing.

The appendages appear to be very like those of *Haliporus thetis*.

The branchial formula is:—

	Pleuro- branchia.	Arthro- branchia.	Podo- branchia.
VII. ....	..	1 (rudimentary)	Ep.
VIII. ....	..	2 (ant. small)	1+Ep.
IX.	1	2	r+Ep.
X.	1	2	r+Ep.
XI.	1	2	Ep.
XII.	1	2	Ep.
XIII.	1	2	Ep.
XIV.	1	0	
	6	13	1+2r+7 Ep.

There is not even a microscopic trace of any podobranch on the epipodites of the second and third pairs of legs, while that of the first pair is present on one side only.

The exopodites of all the ambulatory legs are small but plainly visible.

The points in which this species differs from *Haliporus thetis* are:—the larger branchiostegal spine situated at the lower end of the frontal margin, and not some distance back on the inferior margin; the absence of the two bifurcations of the carina on the carapace, the dorsal carina of the first abdo-

minal segment only occupying about $\frac{1}{4}$ the dorsal length of the segment; the absence of the longitudinal furrows on the sides of the abdominal segments; the shortness of the sixth segment; and a different branchial formula.

One specimen (♀), measuring 160 millim. from tip of rostrum to end of broken telson, was caught at Station 219, 550 fathoms.

BENTHESICYMUS, Spence Bate.

Benthescymus investigatoris, sp. n.

This species is very closely allied to *Benthescymus Bartiletti*, S. I. Smith, agreeing with it except in the following points:—the dactylus of the external maxilliped is truncated, but terminates in a pair of small curved spines apparently functioning as pincers; the fourth abdominal segment is carinated in its posterior three quarters; and the long slender spine is absent from the fifth abdominal tergum.

Station 222, 400–200 fathoms, 2 ♂, 1 ♀.

Station 228, 640 fathoms, 1 ♀.

Station 234, 498 fathoms, 1 ♂, 1 ♀.

Station 235, 370–419 fathoms, 1 ♀.

Family Crangonidæ.

PONTOCARIS, Spence Bate.

Pontocaris media, sp. n.

The only points in which this species disagrees with the description and figures of Spence Bate's *Pontocaris pennata* ('Challenger' Crustacea Macrura, p. 499, pl. xci.) are the following:—

(1) The rostrum is pointed, not bifid at tip.

(2) The infero-lateral carina on either side is bluntly and evenly serrated, not smooth.

(3) The eyes are very much smaller, the orbital notch is more pronounced, and the tooth at its outer angle much larger—the condition of parts being like that of *Pontocaris propensalata* (Spence Bate, *op. cit.* p. 496, pl. xc. fig. 2).

(4) The wing-like processes of the antero-lateral angles of the carapace are not quite so oblique.

(5) As in *P. propensalata*, the fifth, sixth, and seventh thoracic sterna are longitudinally carinated.

(6) The antennal scale is short and subcircular, somewhat as in *P. propensalata*.

From *P. propensalata* it differs in having seven carinæ on the carapace instead of five, and in the far more elaborate sculpture of the abdominal terga, as well as in the greater obliquity of the antero-lateral angles of the carapace.

Four specimens from the Andamans, 55 fathoms.

Family Alpheidæ.

ALPHEUS, Fabr.

Alpheus Shearmii, sp. n.

This species in the frontal region of its carapace resembles *Alpheus tridentatus*, Dana, while the hand of its right chela resembles that of *Alpheus gracilipes*, Stimpson.

The integument is thin and submembranous.

The carapace is perfectly smooth, rounded and non-carinate superiorly; the rostral and supraocular teeth are subequal and very short; the eyes are somewhat deficient in pigment and so small that they cause no projection upwards of the carapace.

Near each postero-lateral angle of the telson is a couple of small spines and on each side of the dorsal surface of the telson is a similar couple of spines.

The telson and plates of the swimmeret are fringed with long hair.

Of the antennular base the first joint is slightly longer than the second and the latter about twice the length of the third. The antennular acicle is flat and tapers quickly from its base to a slender sharp needle-like point reaching about one third the way along the second joint.

The antennal scale is wide, thin and convexly curved in its anterior and inner margins, thickened and slightly concave as to its outer margin, which terminates in a short sharp tooth.

The right great chela, the only one present, is twisted so that the finger and thumb lie horizontally. The lower and inner margin of the hand is quite smooth and continuous with the thumb, the outer and upper margin presents a V-shaped notch close to the articulation of the hand and finger. Running from end to end of the upper surface of the hand, close to its outer margin, is a groove with a well-marked rounded crest on its inner side. The distal end of the crest ends on a level with the notch on the upper margin in a somewhat prominent smoothly rounded eminence.

The opposable edge of the thumb is slightly curved and

armed with two small teeth near the joint, while the corresponding edge of the finger is nearly straight and armed with a single tooth near the joint. The large plug-like tooth usually present on the fingers of shallow-water forms is wholly absent.

Station 232, 430 fathoms, one specimen.

Family Pandalidæ.

PANDALUS, Leach.

Pandalus ? ensis, A. Milne-Edwards.

Pandalus ? ensis, A. Milne-Edwards, Rec. Fig. Crust.

With some doubt we identify with this species three specimens—one perfect with the exception of the fourth and fifth pairs of legs, which are absent, the other two considerably broken, trawled at Station 233, 185 fathoms. They only differ from the figure in possessing three instead of two teeth on the dorsal margin of the rostrum. The position of these three teeth differs in the three specimens, although occupying much the same space as the two teeth of the type. In all other respects our specimens appear to be the same as the type.

CHLOROTOCUS, A. Milne-Edwards.

Chlorotocus gracilipes, A. Milne-Edwards, var. *andamanensis*, nov.

Three specimens were obtained at Station 233, 185 fathoms, and differ from the figure of the species in the Rec. Fig. Crust. in the following points:—the rostrum, in our one unbroken specimen, is armed with four teeth only on its lower margin; there is a small sharp ocular spine; the dorsal carina behind the orbital margin bears five teeth in two, four teeth in one specimen; the postero-inferior angle of the fifth abdominal pleura is pointed and sharp, not rounded; the sixth abdominal pleura is produced postero-inferiorly into a small sharp tooth, not rounded; the telson bears at its extremity, in addition to the sharp central tooth, a pair of lateral movable spines, and between these and the central tooth bunches of long stiff hairs.

HETEROCARPUS, A. Milne-Edwards.

Heterocarpus levigatus, Spence Bate.

Heterocarpus levigatus, Spence Bate, 'Challenger' Macrura, p. 636, pl. cxii. fig. 3.

In one specimen, 178 millim. long from tip of rostrum to end of telson, the dorsal crest is armed with four large teeth, while in seven other specimens there are five teeth on the crest. The under margin of the rostrum is armed with eleven to thirteen teeth. (In Spence Bate's type the rostrum was broken.) In the smaller specimen the rostrum is bent up at an acute angle and the dorsal spines are relatively longer than in the larger specimens.

Station 232, 430 fathoms, eight specimens.

New to the Indian fauna.

PLESIONIKA, Spence Bate.

Plesionika affinis, sp. n.

Closely allied to *Plesionika uniproducta* and *Plesionika unidens*.

Carapace smooth, dorsally carinate in rather more than its anterior half, armed behind the level of the orbit with three procumbent teeth on the carina, which is produced into a slender rostrum rather longer than the dorsal length of the carapace. At first the rostrum curves quickly downwards to the level of the antennules, on reaching which it continues with a slight downward tendency to its tapering extremity. On its dorsal margin above the eye are three procumbent teeth, the most anterior at the level of the cornea, and close to the tip is a minute spinule; on the anterior fourth of its lower margin are some six minute procumbent spinules.

The anterior margin of the carapace is similar in form to that of *Plesionika uniproducta*, and, like it, armed with well-developed teeth corresponding to the antennules and the fronto-lateral angle.

The third abdominal segment in its posterior dorsal quarter is surmounted by an upstanding carina produced posteriorly into a sharp well-marked tooth overhanging the fourth segment. The rest of the abdominal segments are smooth. The sixth segment is rather more than twice the length of the fifth segment.

The second joint of the antennal base is armed with a long sharp tooth like that of *Plesionika uniproducta* (vide 'Challenger' Macrura, pl. cxiii. fig. 1 c).

Two specimens, 36 millim. from tip of rostrum to end of telson, were obtained at Station 236, 172-303 fathoms.

Family Pasiphæidæ.

PASIPHÆA, Savigny, Edw.

Pasiphæa unispinosa, Wood-Mason.

Pasiphæa unispinosa, Wood-Mason, Ann. & Mag. Nat. Hist., Feb. 1893, pp. 163, 164; Illustrations Zoology 'Investigator,' Crustacea, pt. i. 1894, pl. iii. fig. 7, ♀.

Pasiphæa cristata americana, Faxon, Bull. Mus. Comp. Zool. vol. xxiv. p. 203, Aug. 1893.

Pasiphæa americana, Faxon, Mem. Mus. Comp. Zool. vol. xviii. pp. 173-175, pl. xlv. figs. 1-1 e (1895).

Our specimens, both the types and that taken this season, agree in all particulars with Faxon's lucid, concise, and very careful description of *Pasiphæa americana*.

One large female, 116 millim. from anterior end of carapace to end of telson, the terminal few millim. of which are wanting, was taken at Station 229, 360 fathoms.

Family Homaridæ.

NEPHROPSIS, Wood-Mason.

Nephropsis Stewarti, Wood-Mason.

Nephropsis Stewarti, Wood-Mason, Journ. Asiat. Soc. Bengal, vol. xlii. pt. ii. 1873, p. 39, pl. iv., and Ann. & Mag. Nat. Hist. (4) xii. 1873, p. 59; A. Milne-Edward, Ann. Sci. Nat. Zool. (5) xix. pl. xx. figs. 1-3; Alcock & Anderson, Journ. Asiat. Soc. Bengal, vol. lxiii. pt. ii. 1894, p. 161; Anderson, Journ. Asiat. Soc. Bengal, vol. lxv. pt. ii. 1896, p. 96; Ill. Zool. 'Investigator,' Crustacea, pt. iv. pl. xxvii. figs. 1, 1 a (1896).

In this species, as in *Nephropsis atlantica*, the lateral rostral spines are variable in position. In one of the males captured this year, instead of being as usual in the posterior, the spines are situated in the anterior half of the rostrum, which is short, slightly curved, and very similar to the rostrum of *Nephropsis Carpenteri*. In consequence of the shortness of the rostrum the antennular peduncles equal it in length.

Two males, one from Station 229, 360 fathoms, the other from Station 233, 185 fathoms.

Colours in life: upper surface of abdomen very pale orange, extreme outer border of terga bright red, pleuræ white; inner leaf of swimmeret bright red, outer leaf white, bordered by pale orange; upper surface of posterior $\frac{3}{4}$ of carapace orange, suddenly changing to bright red in the anterior $\frac{1}{4}$ and rostrum; sides of carapace white; the two small dorsal tubercles and the faint ridge joining them white; antennular base

white, flagella bright red; antennal base and proximal half of flagellum white, distal half of flagellum pale orange; large cheliped white, except finger and thumb, which are pale orange, extreme tips of finger and thumb white; hands and fingers of second, third, and fourth pairs of walking-legs bright red, remainder of legs white; lower surface of thorax and abdomen white.

Family Callianassidæ.

CALASTACUS, Faxon.

Calastacus felix, sp. n.

This species differs from *Calastacus stilirostris* and *C. investigatoris* in the following particulars:—the carapace is covered with a scanty growth of short, stiff, yellowish, forwardly directed hairs, springing either singly or in groups of two or three from the bottom of small pits in the surface of the test, these hairs being both longer and stouter on the gastric region than elsewhere. The lateral margins of the rostrum, like those of *Calastacus investigatoris*, extend backwards a short distance on either side of the carapace as outstanding ridges, each bearing a couple of spines, the anterior pair of which is much larger than the posterior. A dorsal carina extends from the base of the rostrum to the posterior margin of the carapace, where it ends on a small lobe projecting into the gap left between the backwardly projecting pleuræ of the carapace. The tubercle at the posterior termination of the carina of *C. investigatoris* is only represented in this species by a small irregularity of the carina. Occupying the anterior $\frac{2}{3}$ of the gastric region is a line of small, sharp, forwardly projecting teeth arranged in the form of a horseshoe, with its free ends turned backwards. The rostrum bears on each side a pair of asymmetrically arranged teeth.

A small, somewhat irregular, but pigmented cornea is present.

Of the great cheliped the wrist, near its junction with the hand, is considerably wider than the wrist-hand joint, especially on its lower margin, which projects as a blunt tooth. In the other two species the carpo-propodal joint is as wide as the widest part of the carpus.

Near the centre of the cutting-edge of the immobile finger is a large tooth. The carpus, propodus, and dactylus are covered with long, coarse, but somewhat sparse hair like that on the carapace.

The second pair of walking-legs is absent.

On the hands and fingers of the third and fourth pairs are small corneous prickles, arranged either singly or in transverse rows of two or three.

The abdominal segments are dorsally carinate, the carina being most prominent on the anterior three segments, gradually widening and becoming less and less marked on the fourth, fifth, and sixth segments.

The telson ends in a rounded central lobe, running down to which is a dorsal central groove. On the lateral margins of the telson are a few small teeth and near the proximal end one considerably larger than the others.

A median longitudinal ridge divides the inner plate of the swimmeret into two nearly equal parts and terminates distally in a small sharp tooth. A similar ridge divides the outer plate of the swimmeret into two subequal parts; the movable segment is very small, its inner end just passing beyond the central ridge, and the margin of the suture is armed with a few small acute teeth, as also is the distal half of the outer border of the plate with five similar small teeth.

In *Calastacus investigatoris* and *felix* both male and female external genital orifices are present, as in *Parastacus*, described by Dr. Emar Lönnberg in 'Zool. Anzeiger' of June 2, 1898. On this point Faxon is silent in his description of *Calastacus stilirostris*.

CALLIANASSA, Leach, A. Milne-Edwards.

Callianassa lignicola, sp. n.

This is a small species, the carapace measuring 3.3 millim., the abdomen 11.5 millim.

The form of the carapace resembles that of *Callianassa pachydactyla*, similar longitudinal and oblique grooves being present in both species. Anteriorly it is produced into an acute small rostrum.

The abdominal segments are all smooth. The first is considerably narrower in front than behind; the second, which also increases in width posteriorly, is by far the longest of all the segments and almost twice the length of the first. The telson is well developed, diminishing in width posteriorly, and on its dorsal surface is a broad median furrow expanding posteriorly to the full width of the telson; the end is square, with the corners rounded off. The outer plate of the swimmeret is about $\frac{1}{2}$ longer than the inner plate and armed on its outer straight margin with a small tooth. The pleuræ of all the abdominal segments are very short, smooth, and gently rounded at their margins.

The eye-stalk is triangular in section; its inner margin is prolonged into a short acute spine beyond the level of the cornea, and on its outer side is the small, circular, darkly pigmented cornea.

The peduncle of the first antennæ is about $\frac{1}{3}$ the length of the carapace and terminates in two flattened flagella. The peduncle of the second antennæ is rather longer than that of the first and ends in a tapering slender flagellum about $1\frac{1}{2}$ times the length of the carapace.

The second and third joints of the external maxilliped are expanded to form an irregular oblong cover. On the upper-side of the second joint is a prominent pectinate ridge.

The right is over twice the bulk, although not much longer than the left great cheliped. The lower margin of the ischium is armed with five small, subequal, acute, saw-like teeth; the proximal end of the lower margin of the merus bears one somewhat larger tooth, and the distal three joints, except for a small tooth on the cutting-edge of the thumb, are smooth and unarmed. The second, third, and fourth pairs of legs are of the usual type; the fifth terminates in a mass of hair obscuring the small subchelate finger.

The appendages of the first two abdominal segments are small and slender, the first terminating in a single thin short limb, while the second ends in a pair of slightly stouter limbs. The appendages of the succeeding three segments contrast strongly with the first two pairs; they terminate in a pair of flattened subequal branches fringed with long hair, the outer branch sickle-shaped, the inner lancet-like. On the inner side of each inner limb is a short tooth-like process.

Two specimens, one a female measuring 14.8 millim. in extreme length, the other 11 millim., were obtained from burrows in the interior of water-logged mangrove-twigs at Station 233, 185 fathoms.

Colour in life chalky white.

Family Eryontidæ.

PENTACHELES, Spence Bate.

Pentacheles sculptus, S. I. Smith.

Pentacheles sculptus, S. I. Smith, Bull. Mus. Comp. Zool. x. 1882-83, pp. 28-31, pls. iii., iv.

Polycheles sculptus, Faxon, Mem. Mus. Comp. Zool. vol. xviii. 1895, p. 122, pl. C, fig. 2.

Five specimens (four males, one female) were obtained at Stations 230 and 231, 834 and 836 fathoms respectively.

From tip of rostrum to end of telson they vary from 119 to 74 millim.

All our specimens show the distinctive peculiarities not of Faxon's Pacific variety, but of the typical Atlantic species. In shape and general appearance they resemble *Pentacheles phosphorus*, but can at once be distinguished from this by having two instead of one spine on the outer side of the basal antennular joint, by being armed with one spine instead of two between the rostral spines and the pair of spines about the centre of the gastric area, by having no spines on the carapace posterior to the cervical groove and between the median carina and the sublateral carina, and by the presence of a procumbent spine on the first five instead of the first four abdominal segments.

New to the Indian fauna.

ERYONICUS, Spence Bate.

Eryonicus indicus, sp. n.

Closely resembling *Eryonicus cæcus*, Bate (Faxon), from which it differs in the following particulars:—the dorsal median spines are arranged thus—2 (rostral), 1, 1, 2, 1, 1, 2, 2, 1, 2; the anterior three groups of spines, exclusive of the rostral, are considerably larger than those figured by Faxon; behind the orbit there are but three spinules on the gastric region; the branchial ridge bears 7, not 5 spinules; the last spine on the lateral carina is by far the largest of all those on the animal; the 5 large spines on the lower of the two ridges below the lateral carina are considerably smaller than the last spine of the lateral carina, show no regular diminution in size from the first to the last (indeed, the middle one is the longest), and are both followed and preceded by a row of denticles on the ridge; the dorsal row of spines on the abdomen consists of one spine on the first, second, fifth, and sixth segments and two spines on the third and fourth segments, the spines of each pair being united by a connecting longitudinal ridge, and the posterior spine of each pair much exceeding the anterior in length; on the proximal end of the telson is one spine; only about the inner half of the orbit is filled by the eye-stalk, between which and the outer orbital margin is a wide gap crossed anteriorly by a conical process of the eye-stalk, similar to that of *Eryonicus cæcus*, which, however, does not quite reach the outer margin of the orbit; the basal joint of the first antenna ends in a long internal and a short external spine, and is not fringed

with hair on its inner margin; the second pair of abdominal appendages bear on the inner terminal branch a single long blunt process or stylambliis, and not a pair of processes.

One specimen, measuring 42 millim. from tip of rostrum to end of telson, was obtained at Station 230, 824 fathoms.

There are very good grounds for believing that the specimen came from a considerable depth.

Since writing the above, one of us has trawled a second slightly larger specimen off Colombo in 480-428 fathoms. The colours in life were:—carapace pale brown; abdomen dirty white; swimmeret slightly tinged with pink; first and second antennæ, fingers of great cheliped, and second, third, and fourth pairs of thoracic legs pale pink.

Family Stenopidæ.

? RICHARDINA, A. M.-Edw.

Richardina, A. Milne-Edwards, Recueil de Figures de Crustacés.

A little Crustacean, which was found inhabiting a Hexactinellid sponge dredged at 498 fathoms in the Andaman Sea, closely resembles, and may even perhaps be identical with, the *Richardina spinicincta* figured by M. A. Milne-Edwards on pl. viii. of the work above cited.

It is as closely as possible related to *Stenopus* and *Stenopusculus*, from which it seems to differ chiefly in the stouter and more compact body, in the shorter and less lax appendages, in the reduction of the spinature of the body, and in the complete absence of pigment from the eye.

? *Richardina spongicola*, sp. n.

The cephalothorax, which is of thinner texture than the other parts, is short, broad, and tumid; the prominent posterior edge of the cervical groove is armed with a row of procumbent spines, and a second concentric but shorter row of spines surrounds the base of the rostrum; otherwise the carapace is smooth.

The rostrum, which is nearly a third the length of the rest of the carapace, has the dorsal edge serrated throughout and the ventral edge serrated at the tip only.

The eyes, which are on short stoutish stalks, are quite without pigment and have some spinules round their base dorsally.

The antennal scale is falciform; its outer edge ends in a

first pair of legs, and nearly as long as the combined carapace and rostrum; their ischium and merus are compressed and somewhat broadened.

Except for a few spinules on the carpus of the great cheliped the legs are smooth.

The first three pair of legs are truly chelate and the last two pair are apparently so, since their small dactylus ends in a pair of claws.

The first pair is slender. [The second pair is broken off in our single specimen.] The third pair is of Alphean oddness, the left being slender and non-elongate, while the right is nearly as long as the body without the telson and is very massive, especially as regards the hand. The last two pair have a three-joint carpus and a two-joint propodite.

The abdomen is perfectly smooth except for the telson, which is longitudinally divided into two lobes by a deep groove, the strong convexity of each groove being spiny.

The first pair of abdominal legs in the female are uniramous, the last pair (swimmeret) have the outer edge of the outer lobe serrated.

The single specimen, which is an egg-laden female, measures 26 millim. from the tip of the rostrum to the tip of the telson.

The eggs are few and are of very large size—nearly 1.5 millim. in diameter after contraction in spirit.

Order STOMAPODA.

Squilla leptosquilla, Brooks.

Squilla leptosquilla, W. K. Brooks, 'Challenger' Stomapoda, p. 30, pl. i. figs. 1 & 2.

Three very fine specimens from the Andaman Sea, 185 and 370–419 fathoms. They undoubtedly came from the depths.

Order AMPHIPODA.

Cystisoma spinosum (Fabr.), Stebbing.

Cystisoma spinosum, Stebbing, 'Challenger' Amphipoda, p. 1319, pls. cliv.–clvi.

Two specimens from the Andaman Sea, 498 and 172–303 fathoms. Though they came up in the trawl they were accompanied by such pelagic forms as *Salpa*, *Pyrosoma*, and *Firuloides*, with which no doubt they were associated in life.

XLIV.—*Descriptions of some new Species of Heterocera from Tropical America.* By HERBERT DRUCE, F.L.S. &c.

Fam. Lithosiidæ.

Eudesmia punctata, sp. n.

Male.—Head, thorax, and tegulæ yellow; antennæ black; abdomen yellow, with a black line extending from the base to the anus; the anal segment black; legs yellow. Primaries brown, the veins near the base yellow; a large yellow spot at the end of the cell: secondaries chrome-yellow, broadly bordered with black from the apex to the anal angle and partly along the inner margin, where it is streaked with yellow.

Expanse 1 inch.

Hab. Venezuela, Cucuta (*Mus. Druce*).

Josiodes toxaridia, sp. n.

Male.—Head, antennæ, thorax, and abdomen black, the sides of the abdomen yellow near the base; legs black. Primaries chrome-yellow, the costal margin, apex, outer margin, and a fine line crossing the wing near the apex all black: secondaries chrome-yellow, bordered with black at the apex and outer margin as far as the anal angle.—*Female* similar to the male, but with the black margins rather wider.

Expanse, ♂ ♀, $1\frac{4}{10}$ inch.

Hab. Ecuador, Iutaj (*Buckley, Mus. Druce*).

This species is allied to *Josiodes myrrah*, Cram.

Josiodes entella, sp. n.

Male.—Head, antennæ, thorax, and abdomen black, the last three segments of the abdomen dark blue; a fine yellow line on each side of the abdomen from the base to the anus; legs bluish black. Primaries black, crossed beyond the middle from the costal to the inner margin by a wide chrome-yellow band, and an elongated spot close to the apex of the same colour: secondaries deep black.

Expanse $1\frac{3}{4}$ inch.

Hab. British Guiana (*Whitely, Mus. Druce*).

Eudule donuca, sp. n.

Male.—Head, thorax, and abdomen yellow; antennæ

black; legs yellow. Primaries pale yellow, the apex almost white, with three short black streaks on the white part; two black dots on the costal margin, one at the end of the cell, and there is a straight line below the cell: secondaries yellow; a small black dot at the end of the cell and a dusky streak from the base between the cell and the inner margin; the fringe of both wings black.

Expanse $1\frac{1}{16}$ inch.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

This species is allied to *Eudule tritonis*, Druce.

Eudule lobiformis, sp. n.

Male.—Head, thorax, abdomen, and legs yellow; antennæ black. Primaries semihyaline pale yellow, darkest at the apex and outer margin; the costal margin folded over near the apex, forming a small lobe: secondaries semihyaline pale yellow.

Expanse 1 inch.

Hab. Amazons, Maranhão (*Leech, Mus. Druce*).

A specimen of this species is in the National Collection from Panama, Chiriqui (*Arce*).

Fam. Cyllopodidæ.

Phæochlæna graba, sp. n.

Male.—Head, antennæ, thorax, tegulæ, and legs black, the collar with yellow spots, the tegulæ edged with yellow; abdomen black, the basal segments yellow, the underside white. Primaries dark brown, the veins yellow; a large heart-shaped spot below the cell near the base and a round spot nearer the apex, both chrome-yellow: secondaries chrome-yellow, broadly bordered with black.

Expanse $1\frac{3}{4}$ inch.

Hab. Peru, Rio Napo (*Whitely, Mus. Druce*).

A specimen of this species is in the National Museum.

Phæochlæna amazonica, sp. n.

Male.—Head, collar, and abdomen yellow; antennæ and thorax black; tegulæ black, edged with yellow; abdomen with a black line down the middle and one on each side; the underside and legs yellowish white. Primaries dark brown, the veins pale yellow; a large triangular-shaped pale yellow spot close to the base and a small oval-shaped spot beyond

the cell: secondaries yellow, the costal margin, apex, and outer margin broadly black.

Expanse $1\frac{4}{10}$ inch.

Hab. Amazons, Santarem (Leech, Mus. Druce).

This species is allied to *P. solilucis*, Butl.

Thyrgis ceron, sp. n.

Male.—Head, antennæ, tegulæ, thorax, abdomen, and legs black; the underside of the head yellow. Primaries black, crossed from the middle of the costal margin to the anal angle by a wide pale yellow band: secondaries black, the apex bordered with yellow; the underside the same as above.

Expanse $2\frac{1}{4}$ inches.

Hab. Colombia, Santa Martin, Llanos of Rio Meta (Child); E. Peru (Whitely, Mus. Druce).

This species is allied to *Thyrgis melitta*, Cram.

Getta labana, sp. n.

Male.—The head, tegulæ, thorax, abdomen, and legs brownish black; the underside of the abdomen white. Primaries black, crossed about the middle from the costal margin to the anal angle by a wide cream-coloured band; secondaries brownish black: the underside the same as above, excepting that the secondaries have a large yellow spot at the apex.

Expanse $1\frac{1}{2}$ inch.

Hab. Ecuador, Sarayacu (Buckley, Mus. Druce).

Getta (?) *lysiu*, sp. n.

The head, antennæ, tegulæ, thorax, and abdomen black, the latter banded with white on the underside; underside of the head, base of the palpi, and the anus yellow; a white line down the middle of the thorax. Primaries brownish black, the veins grey; a white band crosses the wing beyond the middle; the band tapers from the costal margin to a point on the outer margin: secondaries black.

Expanse $1\frac{4}{10}$ inch.

Hab. Amazons, Ceara (Leech, Mus. Druce).

Getta ennia, sp. n.

Male.—Head, antennæ, tegulæ, thorax, abdomen, and legs dark brown. Primaries and secondaries dark brown; primaries crossed beyond the middle from the costal margin to

the anal angle by a wide pale yellow band. Underside as above.

Expanse $1\frac{1}{2}$ inch.

Hab. South Brazil (*Mus. Druce*).

Flavinia volumnia, sp. n.

Male.—Head, antennæ, thorax, abdomen, and legs black. Primaries black; a wide band from the base along the inner margin and one crossing the wing from the costal margin to the anal angle both light yellow: secondaries light yellow; the costal margin, apex, outer and inner margin edged with black; a wide black line, becoming wider about the middle, extends from the base to the outer margin.

Expanse $1\frac{1}{2}$ inch.

Hab. East Peru, Rio Napo (*Whitely, Mus. Druce*).

Allied to *Flavinia dichroa*, Perty.

Flavinia Durnfordi, sp. n.

Male.—Head, antennæ, thorax, and abdomen black; the tegulæ pale yellow; the underside of the abdomen yellowish white; legs pale brownish yellow. Primaries black; a small yellow streak from the base partly along the inner margin; a narrow yellow band at the end of the cell, partly crossing the wing from the costal margin to near the anal angle, but not reaching it: secondaries black, with two broad yellow bands from the base to the outer margin, the first band close to the inner margin, the second nearest the apex.—*Female* very similar to the male.

Expanse 1 inch.

Hab. Buenos Ayres (*Durnford, Mus. Druce*).

Flavinia eion, sp. n.

Male.—Head and tegulæ yellow; antennæ, thorax, and abdomen above black; the underside of the abdomen white; a fine yellow line on each side of the abdomen extending from the base to the anus; the legs black. Primaries black, the apex edged with white; a wide yellow streak extends from the base below the cell nearly to the anal angle; a rather broad yellow band crosses the wing beyond the middle: secondaries yellow, the apex and outer margin broadly bordered with black; a submarginal black band extends from the base to the apex; a wide black line extends from the end of the cell to the middle of the outer margin: the underside the same as the upperside.

Expanse $1\frac{1}{4}$ inch.

Hab. Bolivia (*Mus. Druce*).

Flavinia velina, sp. n.

Male.—Head, antennæ, thorax, and the upperside of the abdomen black, the sides of the abdomen yellow; the underside white; the tegulæ yellow at the base; the legs greyish white. Primaries yellow; the costal margin, apex, and outer margin broadly banded with black; no black band crossing the wing, as in *F. postica*, Walk.: secondaries bright yellow, the apex and outer margins broadly bordered with black.

Expanse $1\frac{1}{2}$ inch.

Hab. East Peru (*Whitely, Mus. Druce*).

Micropus ochra, sp. n.

Male.—Head, antennæ, and palpi black; thorax and upper-side of the abdomen black, with a central narrow yellow line extending from the back of the head almost to the anus; the underside of the abdomen white. Primaries yellow, the costal and inner margin edged with black, the apex and outer margin broadly black: secondaries yellow, bordered with black from the apex to the anal angle. Underside as above.—*Female* very similar to the male.

Expanse $1\frac{1}{2}$ inch.

Hab. Venezuela (*Mus. Druce*).

Myonia choba, sp. n.

Male.—Head, antennæ, thorax, tegulæ, and abdomen above black, the underside of the latter white; a spot at the back of the head, a row of spots down the middle of the abdomen, and a line on each side all yellow; legs black above, whitish on the underside. Primaries brownish black, with a round yellow spot on the costal margin nearest the apex: secondaries deep black, crossed about the middle from the costal to the inner margin by a wide yellow band.—*Female* very similar to the male, but with a yellow band on the primaries.

Expanse $1\frac{4}{5}$ inch.

Hab. Amazons, Santarem (*Leech, Mus. Druce*).

Myonia mitys, sp. n.

Male.—Head, antennæ, thorax, and abdomen black; underside of the head yellow; tegulæ yellow, edged with black; a fine white line on each side of the abdomen; the underside and legs white. Primaries black, the veins yellow; a yellow

band partly crosses the wing beyond the middle: secondaries deep black, with a round yellow spot at the end of the cell.

Expanse $1\frac{1}{2}$ inch.

Hab. Amazons, Santarem (*Leech, Mus. Druce*).

Phintia tegyra, sp. n.

Female.—Head, thorax, abdomen, and legs black. Primaries black, partly crossed beyond the middle from the costal margin by a chrome-yellow band: secondaries white, bordered with black.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador (*Whitely, Mus. Druce*).

Devara Carderi, sp. n.

Male.—Head, antennæ, thorax, tegulæ, and abdomen black; the underside of the abdomen and legs yellowish white. Primaries black; an elongated white streak from the base nearly to the middle and a rather large crescent-shaped white band at the end of the cell: secondaries white, bordered with black from the apex to the anal angle.

Expanse $1\frac{1}{4}$ inch.

Hab. Interior of Colombia (*Carder, Mus. Druce*).

Devara (?) *nator*, sp. n.

Female.—Head, collar, tegulæ, thorax, abdomen, and legs blackish brown; antennæ black; tegulæ spotted with yellow. Primaries brown, the veins yellow; a zigzag yellowish-white band crosses the wing about the middle from the costal almost to the inner margin; a yellowish-white spot on the outer margin near the apex: secondaries brownish white, broadly bordered with dark brown, the inner margin broadly shaded with brown.

Expanse $1\frac{3}{4}$ inch.

Hab. Antioqua, Fentino (*Salmon, Mus. Druce*).

Devara eos, sp. n.

Male.—Head, collar, tegulæ, thorax, abdomen, and legs black. Primaries black; a streak at the base and four spots at the end of the cell yellowish white: secondaries white, very broadly bordered with black.

Expanse $1\frac{4}{5}$ inch.

Hab. Ecuador, Chiguinda (*Buckley, Mus. Druce*).

Nelo pyrgion, sp. n.

Male.—Head, antennæ, thorax, abdomen, and legs black. Primaries black, crossed beyond the middle by a dark red band glossed with dark blue: secondaries black: the underside of both wings similar to the upperside, but browner in colour.

Expanse $1\frac{4}{10}$ inch.

Hab. Ecuador, Balsapamba (*Mus. Druce*).

This species is allied to *Nelo tolosa*, Druce.

Nelo choba, sp. n.

Male.—Head, antennæ, thorax, abdomen, and legs black; tegulæ red. Primaries black, shot with bright blue from the base to beyond the middle; a large orange-red spot beyond the cell, glossed with blue: secondaries black, glossed with dark blue from the base to beyond the middle; underside of both wings dark brown, the veins all black, and a large red spot at the base of the secondaries.

Expanse $1\frac{3}{10}$ inch.

Hab. N. Peru (*Krause, Mus. Druce*).

Nelo racilia, sp. n.

Male.—Head, antennæ, tegulæ, thorax, abdomen, and legs black, a reddish spot on the base of the tegulæ; the underside of the abdomen brownish white. Primaries dark brown, with a large, almost central, orange-red spot, pointed at the end of the cell: secondaries dark brown. Underside similar to the upperside, but much paler in colour, and with all the veins black.

Expanse 1 inch.

Hab. Colombia, Pacho, Tolima, Fusagusuga (*Chapman, Mus. Druce*).

This species is allied to *Nelo veliterna*, Druce, and may be the northern form of that insect.

Nelo diasia, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs black. Primaries black, crossed about the middle from the costal margin to the anal angle by a wide orange-yellow band: secondaries blackish brown, the underside pale brown, the veins darker.

Expanse $1\frac{1}{2}$ inch.

Hab. Bolivia (*Garlepp, Mus. Druce*).

Nelo pandia, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs dark brown. Primaries dark brown, with a large oval-shaped orange-yellow spot at the end of the cell: secondaries dark brown, the underside very similar to the upperside, but paler.

Expanse $1\frac{3}{10}$ inch.

Hab. Bolivia (*Garlepp, Mus. Druce*).

Nelo thyrea, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs black. Primaries bluish black, with a large oval white spot at the end of the cell: underside similar to the upperside, but the costal margin and the apex silver-grey, crossed by the black veins: secondaries blue-black, the underside silvery grey, with the veins all black.

Expanse $1\frac{4}{10}$ inch.

Hab. Bolivia (*Garlepp, Mus. Druce*).

Nelo hermæa, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs black. Primaries black, with a large oval-shaped chrome-yellow spot beyond the band crossed with black veins: secondaries deep black; the underside greyish black, with all the veins black.

Expanse $1\frac{3}{4}$ inch.

Hab. Ecuador, Balsapamba (*Mus. Druce*).

This species is allied to *Nelo paterna*, Druce.

Sangala superba, sp. n.

Male.—Head, antennæ, thorax, and tegulæ black; abdomen above blue-black, the sides striped with bright red, the underside black; legs black. Primaries dark glossy blue, with a large bright red band crossing the wing at the end of the cell from the costal margin almost to the anal angle; on the underside the band is pale orange-colour: secondaries glossy dark blue, the underside dark brown; all the veins black; the costal margin and a streak between each vein bright red.

Expanse 2 inches.

Hab. Colombia, Manaure (*F. Simons, Mus. Druce*).

Scotura avara, sp. n.

Male.—Head, antennæ, thorax, abdomen, and legs black; front of head and tegulæ greyish; a white line extends down the middle of the abdomen from the base almost to the anus; the underside white. Primaries black, the veins white from the base to the middle; a wide white band crosses the wing about the middle, but does not quite reach the costal margin: secondaries semihyaline white, broadly bordered with black at the apex and round the outer margin. The underside very similar to the upperside, the secondaries with a white spot at the apex.

Expanse $1\frac{1}{2}$ inch.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

Fam. Dioptidæ.

Polypætes cistrina, sp. n.

Male.—Head and antennæ black, underside of the head yellow; thorax and tegulæ brown, the latter edged with white; a yellow spot on the base of the tegulæ; abdomen black, grey at the base and white on the underside; legs black. Primaries brown, the veins and a spot on the outer margin near the apex yellow; a rather wide white band partly crosses the wing from about the middle of the costal margin: secondaries white, broadly bordered with black at the apex and round the outer margin.

Expanse $1\frac{1}{2}$ inch.

Hab. Ecuador, Chiguinda (*Buckley, Mus. Druce*).

Polypætes mirma, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs black, the underside of the abdomen white. Primaries from the base to about the middle white, but slightly dusky close to the base; the outer half of the wing black; a small streak at the end of the cell and two small spots close to the apex white: secondaries white, broadly bordered with black.

Expanse 1 inch.

Hab. Bolivia (*Garlepp, Mus. Druce*).

Astyochia dolens, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs black. Primaries semihyaline black, darkest along the costal margin, at the end of the cell, and at the apex; a whitish

spot between the end of the cell and the apex: secondaries semihyaline white, broadly bordered with black; the veins all black.

Expanse 1 inch.

Hab. Bolivia (*Garlepp, Mus. Druce*).

Astyochia ithra, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs black. Primaries black, slightly hyaline at the base; on the underside the apex is grey: secondaries white, very broadly bordered with black.

Expanse $1\frac{1}{10}$ inch.

Hab. Bolivia (*Garlepp, Mus. Druce*).

XLV.—*Foraminifera from the "Cambridge Greensand."*

By FREDERICK CHAPMAN, A.L.S., F.R.M.S.

PART II. *

Subfamily *NODOSABINÆ* (continued).

FRONDICULARIA, DeFrance [1824].

Frondicularia inversa, Reuss.

Frondicularia inversa, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 31, pl. viii. figs. 15-19, pl. xiii. fig. 42; Chapman, 1894, Journ. R. Micr. Soc. pp. 155, 156, pl. iii. fig. 8.

A well-known species in the Gault and Chalk. At Folkestone it was found only in zone x.

A few fragments from Swaffham.

Frondicularia lanceola, Reuss.

Frondicularia lanceola, Reuss, 1860, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xl. p. 198, pl. v. fig. 1; Chapman, 1894, Journ. R. Micr. Soc. p. 157, pl. iii. fig. 15.

Two specimens, one of which is fragmentary, were found at Swaffham.

Frondicularia Unger, Reuss.

Frondicularia Unger, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xvi. p. 54, pl. iv. figs. 11 a, b; Chapman, 1894, Journ. R. Micr. Soc. p. 157, pl. iii. fig. 16.

Two specimens from Swaffham.

* For Part I. see this Magazine for January 1899, pp. 48-66.

Frondicularia Parkeri, Reuss.

Frondicularia Parkeri, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xli. p. 91, pl. xii. fig. 7; Chapman, 1894, Journ. R. Micr. Soc. p. 157, pl. iii. fig. 17.

Four good specimens of this species were found at Swaffham, one of which bears upon its lateral surface the initial chambers of *Vitriwebbina Sollasi*.

Frondicularia guestphalica, Reuss.

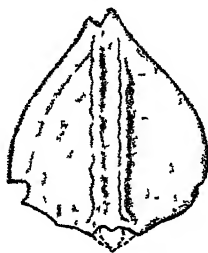
Frondicularia guestphalica, Reuss, 1860, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xl. p. 195, pl. vi. fig. 2; Chapman, 1894, Journ. R. Micr. Soc. p. 158, pl. iv. fig. 2.

Two specimens from Swaffham.

Frondicularia striga, sp. n. (Fig. 1.)

Lateral outline of test subovate, acuminate; the oral end more produced; complanate, with the surface nearly even, but relieved by two strong riblets running vertically down the middle of the test and covering the oral terminations of

Fig. 1.



Frondicularia striga, sp. n. $\times 15$.

each chamber. The margins of the chambers not marked by very strong shell-thickening as in some species having the same general outline. Edge of the test slightly grooved. The shell-surface under a high power appears finely granulated or rippled. Length of type specimen 1.9 millim.; breadth 1.4 millim.; thickness of edge .133 millim.

This species appears to be quite distinct from any previously figured. In outline it somewhat resembles *F. perovata*, Chapman*, but is not so regularly ovate, and the sutural margins of the chambers are not incurved towards the aboral

* Journ. R. Micr. Soc. 1894, pp. 158, 159, pl. iv. figs. 5 a, b.

end. *F. Cordai*, Reuss*, is near to *F. striga* in its general outline, but it bears no double riblet on the shell-surface. These vertical costulæ are comparable with the same structures forming a marked feature in *F. Fritschii*, Perner†. The latter species, however, belongs to the group with much elongated tests, and I have never met with any intermediate and broader specimens of *F. Fritschii* than those figured in the paper dealing with the *Froniculariæ* from the Gault of Folkestone under the name of *F. pinnæformis* (= *F. Fritschii*, Perner‡).

The specimens recorded by G. R. Vine from the Cambridge Greensand as "*Fronicularia*, var. with two parallel longitudinal ribs," may either belong to this present species or to *F. Fritschii*.

Three specimens of *F. striga* with fairly constant characters, but all slightly broken, were found in the Cambridge Greensand of Swaffham.

Fronicularia Archiaciana, d'Orbigny.

Fronicularia Archiaciana, d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 20, pl. i. figs. 34-36; Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 31, pl. xiii. fig. 29; Chapman, 1894, Journ. R. Micr. Soc. p. 155, pl. iii. fig. 6.

A broken specimen was found at Swaffham which bears vertical striæ on its lateral surfaces similar to those found in the Gault of Folkestone and the Chalk of Bohemia.

FLABELLINA, d'Orbigny [1826].

Flabellina didyma (Berthelin).

Fronicularia didyma, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 61, pl. ii. figs. 18 a, b.

Flabellina didyma (Berthelin), Chapman, 1894, Journ. R. Micr. Soc. p. 159, pl. iv. fig. 7.

One specimen from Swaffham.

RHABDOGONIUM, Reuss [1860].

Rhabdogonium excavatum, Reuss.

Rhabdogonium excavatum, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xvi. p. 91, pl. xii. fig. 8; Chapman, 1894, Journ. R. Micr. Soc. p. 160, pl. iv. figs. 9 a, b.

* Verstein. böhm. Kreidef. 1845, pt. i. p. 31, pl. viii. figs. 26-28, pl. xiii. fig. 41.

† "Foraminifery Ceského Cenomanu" (Pal. Bohemiæ, no. 1), 1892, p. 58, pl. vii. figs. 1 a-d.

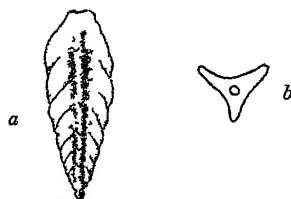
‡ Journ. R. Micr. Soc. 1894, p. 156, pl. iii. figs. 9-11.

In the Gault this species appears to be confined to the uppermost zones. It is somewhat frequent at Swaffham.

Rhabdogonium excavatum, Reuss, var. *exilis*, nov.
(Fig. 2.)

This variety is distinguished from the typical *R. excavatum* by the elongate form and extreme tenuity of its test. The primordial segment is separated from the rest of the shell by

Fig. 2.



Rhabdogonium excavatum, Reuss, var. *exilis*, nov. $\times 30$.
a, lateral view; *b*, oral aspect.

a conspicuous constriction. Length .9 millim.; breadth at the widest part of the oral extremity .3 millim.

The figured specimen was obtained from the Cambridge Greensand of Swaffham.

MARGINULINA, d'Orbigny [1826].

Marginulina glabra, d'Orbigny.

Marginulina glabra, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 259, no. 6; Modèle, no. 55; Chapman, 1894, Journ. R. Micr. Soc. p. 160, pl. iv. figs. 11 *a*, *b*.

Two specimens from the Greensand of Swaffham.

Marginulina hamulus, Chapman.

Marginulina hamulus, Chapman, 1894, Journ. R. Micr. Soc. p. 161, pl. iv. figs. 13 *a*, *b*.

Two specimens, in both of which the test does not so rapidly increase in size as the specimens figured from the Folkestone Gault, were found at Swaffham.

Marginulina linearis, Reuss.

Marginulina linearis, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xli. p. 60, pl. v. fig. 15; Chapman, 1894, Journ. R. Micr. Soc. p. 161, pl. iv. fig. 14.

Rare at Swaffham.

Marginulina soluta, Reuss.

Marginulina soluta, Reuss, 1860, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xl. p. 206, pl. vii. fig. 4.

This species is easily recognized by the bulb-like initial segment and the prominent tubular oral termination. This form has not been met with up to the present in the Folkestone Gault. It was found by Reuss in the Chalk of Westphalia.

Four specimens from the Greensand of Swaffham.

Marginulina equivoca, Reuss.

Marginulina equivoca, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 60, pl. v. fig. 17; Chapman, 1894, Journ. R. Micr. Soc. p. 162, pl. iv. fig. 20.

Three specimens, one of which has a greatly prolonged tubular aperture, were found at Swaffham.

Marginulina striatocostata, Reuss.

Marginulina striatocostata, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 62, pl. vi. fig. 2; Chapman, 1894, Journ. R. Micr. Soc. p. 163, pl. iv. fig. 21.

Two specimens were found at Swaffham.

Marginulina Jonesi, Reuss.

Marginulina Jonesi, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 61, pl. v. fig. 19; Chapman, 1894, Journ. R. Micr. Soc. p. 163, pl. iv. fig. 24.

One specimen from Swaffham.

VAGINULINA, d'Orbigny [1826].

Vaginulina recta, Reuss.

Vaginulina recta, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 48, pl. iii. figs. 14, 15; Chapman, 1894, Journ. R. Micr. Soc. p. 422, pl. viii. figs. 1 a, b.

This species is fairly common at Swaffham.

Vaginulina recta, Reuss, var. *tenuistriata*, Chapman.

Vaginulina recta, Reuss, var. *tenuistriata*, Chapman, 1894, Journ. R. Micr. Soc. pp. 422, 423, pl. viii. fig. 2.

This variety is common at Swaffham.

Vaginulina truncata, Reuss.

Vaginulina truncata, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 47, pl. iii. fig. 9; Chapman, 1894, Journ. R. Micr. Soc. pp. 423, 424, pl. viii. figs. 5 a, b, 6.

It is difficult to define the limits of the type form of this species, for it passes so insensibly into the robust variety with the redundant shell-growth. Variations of *V. truncata*, in which the later segments are Frondicularian, are met with in the Cambridge Greensand, similar to those which were found in the Gault of Folkestone*.

V. truncata is very common at Swaffham.

Vaginulina truncata, Reuss, var. *robusta*,
Berthelin & Chapman.

Vaginulina truncata, Reuss, "var. très robuste," Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 40, pl. ii. figs. 4 a, b.

Vaginulina truncata, Reuss, var. *robusta*, Chapman, 1894, Journ. R. Micr. Soc. pp. 424, 425, pl. viii. figs. 7 a, b.

This variety is equally abundant with the type form at Swaffham.

Vaginulina truncata, var. *eurynota*, Reuss.

Vaginulina eurynota, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 90, pl. xii. fig. 9; Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc. p. 559, pl. x. fig. 9.

In the Gault series this curved form of *Vaginulina* was found to graduate into what may be regarded as the type form—*V. truncata*—and was included under that name in the descriptive papers on the Folkestone Foraminifera. An extremely good specimen of this variation was found in the Cambridge Greensand of Swaffham, and is here regarded as a variety of *V. truncata*.

Vaginulina arguta, Reuss.

Vaginulina arguta, Reuss, 1860, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xl. p. 202, pl. viii. fig. 4; Chapman, 1894, Journ. R. Micr. Soc. p. 425, pl. viii. figs. 9 a, b.

One specimen from Swaffham.

Vaginulina striolata, Reuss.

Vaginulina striolata, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 46, pl. iii. fig. 7; Chapman, 1894, Journ. R. Micr. Soc. pp. 425, 426, pl. viii. fig. 10.

This species was represented in the series from the Upper

* Cf. Journ. R. Micr. Soc. 1898, p. 14, pl. ii. fig. 13
23*

Gault at Folkestone by a single specimen, and it is also unique in the collection from the Cambridge Greensand of Swaffham.

Vaginulina comitina, Berthelin.

Vaginulina comitina, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 38, pl. i. figs. 21 *a-d*; Chapman, 1894, Journ. R. Micr. Soc. p. 426, pl. viii. fig. 11.

This species has previously been described from the Gault of France and England, and it has also occurred in the Chalk detritus of Charing, Kent. It is rare at Swaffham.

Vaginulina Biochei, Berthelin.

Vaginulina Biochei, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 42, pl. ii. figs. 9 *a, b*; Chapman, 1894, Journ. R. Micr. Soc. p. 427, pl. viii. figs. 14 *a, b*.

This rare form was originally described from the French Gault, and it has also been found in the Gault of Folkestone. One specimen from the Cambridge Greensand at Swaffham.

CRISTELLARIA, Lamarck [1816].

Cristellaria linearis, Reuss.

Cristellaria linearis, Reuss, 1862, Sitzungs. d. k. Ak. Wiss. Wien, vol. xlv. p. 66, pl. xii. figs. 1 *a, b*; Chapman, 1894, Journ. R. Micr. Soc. pp. 645, 646, pl. ix. figs. 1 *a, b*.

Very rare at Swaffham.

Cristellaria parallela, Reuss.

Cristellaria parallela, Reuss, 1862, Sitzungs. d. k. Ak. Wiss. Wien, vol. xlv. p. 67, pl. vii. figs. 1, 2; Chapman, 1894, Journ. R. Micr. Soc. p. 647, pl. ix. figs. 5 *a, b*.

This occurrence extends the range of the species upward, being formerly known from Neocomian, Aptian, and Albian beds, and only as high as zone v. at Folkestone.

Very rare at Swaffham.

Cristellaria cymboides, d'Orbigny.

Cristellaria cymboides, d'Orbigny, 1846, Foram. Foss. Vienne, p. 85, pl. iii. figs. 30, 31; Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc. p. 560, pl. xi. fig. 6; Chapman, 1894, *ibid.* p. 647, pl. ix. figs. 6 *a, b*.

One specimen from Swaffham.

Cristellaria crepidula (Fichtel & Moll).

Nautilus crepidula, Fichtel & Moll, 1798, Test. Micr. p. 107, pl. xix. figs. *g-i*.

Cristellaria crepidula (Fichtel & Moll), d'Orbigny, 1839, Foram. Cuba, p. 64, pl. viii. figs. 17, 18; Chapman, 1894, Journ. R. Micr. Soc. p. 648, pl. ix. figs. 8 *a, b*.

One specimen from Swaffham.

Cristellaria gladius (Philippi).

Marginulina gladius, Philippi, 1843, Beitr. z. Kenntniss d. Tertiärf. nordwest. Deutschl. p. 40, pl. i. fig. 37.

Cristellaria gladius (Philippi), Hantken, 1875, Mittheil. a. d. Jahrb. k. ungar. geol. Anstalt, p. 51, pl. v. fig. 12; Chapman, 1894, Journ. R. Micr. Soc. p. 649, pl. ix. figs. 11 *a, b*.

Two very typical specimens from Swaffham.

Cristellaria Bronni (Römer).

Planularia Bronni, Römer, 1841, Verstein. d. nordd. Kreidegeb. p. 97, pl. xv. fig. 14.

Cristellaria Bronni (Römer), Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlvi. p. 70, pl. vii. figs. 13 *a, b*; Chapman, 1894, Journ. R. Micr. Soc. pp. 649, 650, pl. ix. figs. 12 *a, b*, 13 *a, b*.

One slightly damaged specimen from Swaffham.

Cristellaria sulcifera, Reuss.

Cristellaria sulcifera, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlvi. pp. 74, 93, pl. viii. figs. 8 *a, b*; Chapman, 1894, Journ. R. Micr. Soc. pp. 650, 651, pl. x. figs. 2 *a, b*.

Rare at Swaffham.

Cristellaria triangularis, d'Orbigny.

Cristellaria triangularis, d'Orbigny, 1840, Mém. Soc. géol. France, sér. 1, vol. iv. p. 27, pl. ii. figs. 21, 22; Chapman, 1894, Journ. R. Micr. Soc. p. 651, pl. x. figs. 3 *a, b*.

One characteristic specimen from Swaffham.

Cristellaria trunculata, Berthelin.

Cristellaria trunculata (pars), Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 53, pl. iii. figs. 27 *a, b*; Chapman, 1894, Journ. R. Micr. Soc. p. 651, pl. x. figs. 4 *a, b*.

Rare at Swaffham.

Cristellaria oligostegia, Reuss.

Cristellaria oligostegia, Reuss, 1860, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xl. p. 213, pl. viii. fig. 8; Chapman, 1894, Journ. R. Micr. Soc. pp. 651, 652, pl. x. figs. 5 a, b.

This species is somewhat rare at Swaffham.

Cristellaria scitula, Berthelin.

Cristellaria scitula, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 53, pl. iii. figs. 3 a-c; Chapman, 1894, Journ. R. Micr. Soc. p. 652, pl. x. figs. 7 a, b.

Very rare at Swaffham.

Cristellaria complanata, Reuss.

Cristellaria complanata, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 33, pl. xiii. fig. 54; Chapman, 1894, Journ. R. Micr. Soc. pp. 653, 654, pl. x. figs. 12 a, b.

One very fine example from the Cambridge Greensand of Swaffham.

Cristellaria turgidula, Reuss.

Cristellaria turgidula, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 73, pl. viii. figs. 4 a, b; Chapman, 1896, Journ. R. Micr. Soc. pp. 1, 2, pl. i. figs. 1 a, b.

Very rare at Swaffham.

This record extends the range of the form upward, it having been noticed previously in the various divisions of the Albian stage.

Cristellaria circumcidanea, Berthelin.

Cristellaria circumcidanea, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 52, pl. iii. figs. 1 a, b; Chapman, 1896, Journ. R. Micr. Soc. pp. 2, 3, pl. i. figs. 2 a, b.

This species is common at Swaffham.

Cristellaria convergens, Bornemann.

Cristellaria convergens, Bornemann, 1855, Zeitschr. d. deutsch. geol. Gesellsch. vol. vii. p. 327, pl. xiii. figs. 16, 17; Chapman, 1896, Journ. R. Micr. Soc. p. 4, pl. i. figs. 6 a, b.

One specimen from Swaffham.

Cristellaria gibba, d'Orbigny.

Cristellaria gibba, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 292, no. 17; Chapman, 1896, Journ. R. Micr. Soc. pp. 4, 5, pl. i. figs. 7 a, b.

This species is common at Swaffham.

Cristellaria rotulata (Lam.).

Lenticulites rotulata, Lamarck, 1804, Annales du Muséum, vol. v. p. 188, no. 3; Tableau Encycl. et Méth. pl. cccclxvi. fig. 5.

Cristellaria rotulata (Lam.), d'Orbigny, 1840, Mém. Soc. géol. France, sér. 1, vol. iv. p. 26, pl. ii. figs. 15-18; Chapman, 1896, Journ. R. Micr. Soc. pp. 5, 6, pl. i. figs. 8 *a*, *b*.

This species was recorded by G. R. Vine from Cambridge. It is common at Swaffham.

Cristellaria rotulata (Lam.), var. *macrodiscus*, Reuss.

Cristellaria macrodisca, Reuss, 1862, Sitzungsber. d. k. Ak. Wiss. Wien, vol. xlv. p. 78, pl. ix. figs. 5 *a*, *b*.

Cristellaria rotulata (Lam.), var. *macrodiscus*, Reuss, Chapman, 1896, Journ. R. Micr. Soc. pp. 6, 7, pl. i. figs. 9 *a*, *b*.

This variety is frequent at Swaffham.

Cristellaria gaultina, Berthelin.

Cristellaria gaultina, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 49, pl. iii. figs. 15-19; Chapman, 1896, Journ. R. Micr. Soc. pp. 7, 8, pl. i. figs. 10 *a*, *b*, 11.

This species ranges throughout the Gault, besides occurring at several horizons above the Cenomanian. In the Cambridge Greensand of Swaffham and elsewhere *C. gaultina* is excessively common and attains to a great size, some specimens being 3 millim. across the disk.

Cristellaria sternalis, Berthelin.

Cristellaria sternalis, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 54, pl. iii. figs. 2 *a*, *b*; Chapman, 1896, Journ. R. Micr. Soc. p. 8, pl. ii. figs. 1 *a*, *b*.

This species does not attain to so large a size in the Cambridge Greensand as in the Gault. It is frequent at Swaffham.

Cristellaria diademata, Berthelin.

Cristellaria diademata, Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 51, pl. iii. figs. 4, 5, 12, & 13; Chapman, 1896, Journ. R. Micr. Soc. p. 8, pl. ii. figs. 2 *a*, *b*.

One fine specimen from the Greensand of Swaffham.

Subfamily *POLYMORPHININÆ*.*POLYMORPHINA*, d'Orbigny [1826].

Polymorphina lactea (Walker & Jacob), var. *acuplacentia*,
Jones & Chapman.

Polymorphina lactea (W. & J.), "Fistulose form," Chapman, 1896,
Journ. R. Micr. Soc. p. 9, pl. ii. fig. 4.

Polymorphina spp., var. *acuplacentia*, Jones & Chapman, 1896, Journ.
Linn. Soc., Zoology, vol. xxv. p. 502, figs. 6-9.

The apical outgrowths of this specimen particularly resemble those seen in fig. 8, p. 502 of Jones and Chapman's summary of the fistulose *Polymorphinæ* (tom. *suprà cit.*).

One specimen from Swaffham.

Polymorphina gibba, d'Orbigny, var. *acuplacentia*,
Jones & Chapman.

Polymorphina gibba, d'Orbigny, "Fistulose form," Chapman, 1896,
Journ. R. Micr. Soc. p. 10, pl. ii. fig. 6.

Polymorphina gibba, d'Orbigny, var. *acuplacentia*, Jones & Chapman,
1896, Journ. Linn. Soc., Zoology, vol. xxv. p. 502, figs. 6, 7.

The specimens, of which there are two in this series from the Cambridge Greensand of Swaffham, are perhaps more nearly comparable with fig. 6, p. 502 of Jones and Chapman's summary than with the Gault specimen.

Polymorphina gutta, d'Orbigny, var. *diffusa*,
Jones & Chapman.

Polymorphina gutta, d'Orbigny, "Fistulose form," Chapman, 1896,
Journ. R. Micr. Soc. p. 10, pl. ii. fig. 6.

Polymorphina spp., var. *diffusa*, Jones & Chapman, 1896, Journ. Linn.
Soc., Zoology, vol. xxv. p. 505, figs. 26-29.

Four specimens, all more or less resembling those from the Folkestone Gault, were found at Swaffham.

Polymorphina fusiformis, Römer.

Polymorphina (*Globulina*) *fusiformis*, Römer, 1838, Neues Jahrb. für
Min. p. 386, pl. iii. fig. 37.

Polymorphina fusiformis, Römer, Chapman, 1896, Journ. R. Micr. Soc.
p. 11, pl. ii. fig. 9.

Three specimens belonging to the type species were found at Swaffham.

Polymorphina fusiformis, Römer, var. *horrida*, Reuss.

Polymorphina horrida, Wright, 1875, Rep. & Proc. Belf. Nat. Field-Club for 1873-74, Appendix, 1875, p. 85, pl. iii. fig. 14.

Polymorphina fusiformis, Römer, "Fistulose form," Chapman, 1896, Journ. R. Micr. Soc. pp. 11, 12, pl. ii. fig. 10.

Polymorphina fusiformis, Römer, var. *horrida*, Reuss, Jones & Chapman, 1896, Journ. Linn. Soc., Zoology, vol. xxv. p. 503, fig. 14.

The solitary specimen found at Swaffham more nearly resembles the Chalk specimen found by Mr. Wright than that figured from the Gault series. The original specimen of von Reuss* belongs to the species *P. gutta*.

Polymorphina fusiformis, Römer, var. *acuplacentia*, Jones & Chapman.

The variety here under consideration has apparently never hitherto been found associated with the type species *P. fusiformis*. The nearest figured form of outgrowth which the specimens from the Cambridge Greensand resemble is that of fig. 9, p. 502 of the summary of the fistulose *Polymorphinæ* (*op. cit.*), although in that specimen the outgrowths are much more produced.

Three specimens of *P. fusiformis*, var. *acuplacentia*, were found at Swaffham.

Polymorphina sororia, Reuss, var. *cuspidata*, Brady.

Polymorphina sororia, Reuss, var. *cuspidata*, Brady, 1884, Chall. Rep. vol. ix. p. 563, pl. lxxi. figs. 17-19, pl. lxxii. fig. 4; Chapman, 1896, Journ. R. Micr. Soc. p. 13, pl. ii. fig. 13.

This variety has been recorded from the Aptian of Guildford, the Gault of Folkestone, and the Red Chalk of Speeton. Only one specimen was found at Swaffham.

Polymorphina communis, d'Orbigny.

Polymorphina (Guttulina) communis, d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 206, pl. xii. figs. 1-4; Modèle, no. 62.

Polymorphina communis, d'Orb., Chapman, 1896, Journ. R. Micr. Soc. pp. 13, 14, pl. ii. fig. 15.

One specimen from Swaffham.

* "*Globulina horrida*," Reuss, 1845, Verstein. böhm. Kreidef. pt. ii. p. 110, pl. xliii. fig. 14.

Subfamily *RAMULININÆ*.*RAMULINA*, Rupert Jones [1875].*Ramulina globulifera*, Brady.

Ramulina globulifera, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 58, pl. viii figs. 32, 33; Chapman, 1896, Journ. R. Micr. Soc. pp. 582, 583, pl. xii. figs. 3-6.

Numerous double and single segments of this species were found at Swaffham.

Ramulina aculeata, Wright.

Ramulina aculeata, Wright, 1886, Proc. Belf. Nat. Field-Club, 1885-86, Appendix ix. 1886, p. 331, pl. xxvii. fig. 11.

Lagena tuberculata, Perner, 1892, Česká Ak. Císarè Františka Josefa, Prague (Palæont. Bohemiæ, no. 1), p. 56, pl. v. figs. 19 a, b.

Ramulina aculeata, Wright, Chapman, 1896, Journ. R. Micr. Soc. pp. 583, 584, pl. xii. figs. 7-9.

This species is well known in nearly all washings from the Cretaceous beds, and has occurred in the Cenomanian of Bohemia. It is abundantly represented in the Cambridge Greensand of Swaffham by slender stoloniferous fragments and bulbous and bifurcated portions.

VITRIWEBBINA, Chapman [1892].*Vitriwebbina lævis* (Sollas).

Webbina lævis, Sollas, 1877, Geol. Mag. dec. ii. vol. iv. pp. 103, 104, pl. vi. figs. 1-3.

Vitriwebbina lævis (Sollas), Chapman, 1892, Geol. Mag. dec. iii. vol. viii. p. 53, pl. ii. fig. 4; id. 1896, Ann. & Mag. Nat. Hist. vol. xviii. p. 332, fig. 3; id. Journ. R. Micr. Soc. pp. 585, 586, pl. xii. fig. 12.

Vitriwebbina lævis (Sollas), Bagg, 1898, Bull. U.S. Geol. Survey, no. 88, p. 36, pl. ii. figs. 4 a, b.

This form was originally described from the Cambridge Greensand under the generic name *Webbina* as recorded by Sollas and Vine. It has since been found in the Middle Marl of New Jersey, in the Gault of Folkestone, and in the lowest beds of the Chalk strata.

One specimen of *Vitriwebbina lævis* attached to a glauconitic fragment was found in the washings from Swaffham.

Vitriwebbina Sollasi, Chapman.

Vitriwebbina Sollasi, Chapman, 1892, Geol. Mag. dec. iii. vol. viii. p. 53, pl. ii. figs. 1-3.

Vitriwebbina Sollasi, Chapman, Bagg, 1898, Bull. U.S. Geol. Survey, no. 88, pp. 35, 36, pl. ii. figs. 5 a, b.

This species was first recorded from the Gault. It has since been found in the Middle Marl of New Jersey and in the lowest beds of the Chalk.

Vitriwebbina tuberculata (Sollas). (Fig. 3.)

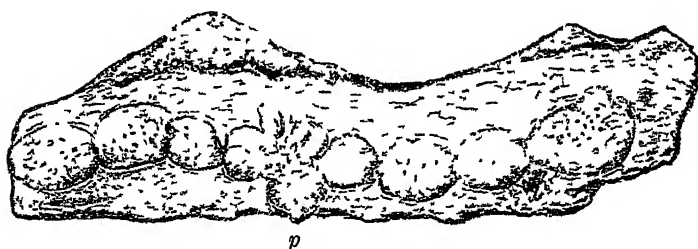
Webbina tuberculata, Sollas, 1877, Geol. Mag. dec. ii. vol. iv. p. 104, pl. vi figs. 4-7 & 9.

Trochammina irregularis (d'Orbigny), Perner, Česká Ak. Císarè Frantiska Josefa, Prague (Palæont. Bohem. no. 1), p. 53, pl. ix. figs. 1-6.

Vitriwebbina tuberculata (Sollas), Chapman, 1896, Ann. & Mag. Nat. Hist. vol. xviii. p. 332, fig. 4; id. 1896, Journ. R. Micr. Soc. pp. 533, 587, pl. xiii. fig. 3.

By far the finest specimen of this form I have met with is here figured from the Cambridge Greensand of Swaffham (fig. 3). It is remarkable for having no less than ten

Fig. 3.



Vitriwebbina tuberculata (Sollas). $\times 15$.
p = primordial segment.

segments, and by its completeness throws considerable light on one of the methods of its growth. *Vitriwebbina* is more usually found as a series of chambers of gradually increasing size; but the specimen before us gives an instance of a deviation from this general habit. The primordial segment in this specimen immediately gives rise to a double series of chambers of about equal dimensions extended laterally on either side of the commencement. This specimen is attached to a brown (?) fish-bone fragment.

Originally described from the Cambridge Greensand, this species has since been found in the Gault of Merstham and Folkestone and in the Cenomanian and Chalk of Bohemia. Six specimens of *Vitriwebbina tuberculata* occur in this present series from the Cambridge Greensand of Swaffham.

Family Globigerinidæ.

GLOBIGERINA, d'Orbigny [1826].

Globigerina cretacea, d'Orbigny.

Globigerina cretacea, d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 34, pl. iii. figs. 12-14; Chapman, 1896, Journ. R. Micr. Soc. pp. 588, 589, pl. xiii. figs. 5, 6.

This species was formerly recorded by Vine from the Cambridge Greensand. It is very common at Swaffham.

Globigerina æquilateralis, Brady.

Globigerina æquilateralis, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 7; id. 1884, Chall. Rep. vol. ix. p. 605, pl. lxxx. figs. 18-21; Chapman, 1896, Journ. R. Micr. Soc. p. 589, pl. xiii. fig. 7.

Rare at Swaffham.

Family Rotaliidæ.

Subfamily ROTALIINÆ.

ANOMALINA, d'Orbigny [1826].

Anomalina complanata, Reuss.

Anomalina complanata, Reuss, 1851, Haidinger's Naturw. Abhandl. vol. iv. (1) p. 36, pl. iii. fig. 3; Chapman, 1893, Journ. R. Micr. Soc. pp. 3, 4, pl. i. figs. 4 a-c.

Very rare at Swaffham.

Anomalina ammonoides (Reuss).

Rosalina ammonoides, Reuss, 1845, Verstein. böhm. Kreidef. pt. i. p. 36, pl. xiii. fig. 66, pl. viii. fig. 53.

Anomalina ammonoides (Reuss), Brady, 1884, Chall. Rep. vol. ix. p. 672, pl. xciv. figs. 2, 3; Chapman, 1898, Journ. R. Micr. Soc. pp. 4, 5, pl. i. figs. 5 a-c.

This species has been previously recorded from the Cambridge Greensand by G. R. Vine. It is very abundant at Swaffham.

Anomalina rudis (Reuss).

Rosalina rudis, Reuss, 1862, Sitzungsab. d. k. Ak. Wiss. Wien, vol. xlv. p. 87, pl. xi. figs. 7 a-c.

Anomalina rudis (Reuss), Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 68, pl. iv. figs. 15 a-c; Chapman, 1898, Journ. R. Micr. Soc. p. 5, pl. i. figs. 6 a-c.

Occasional at Swaffham.

ROTALIA, Lamarck [1804].

Rotalia Soldanii (d'Orbigny), var. *nitida*, Reuss.*Rotalina nitida*, Reuss, 1844, Geogn. Skizze Böhmen, vol. ii. pt. 1, p. 214.*Placentula nitida* (Reuss), Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. no. 5, p. 69, pl. iv. figs. 11 a-c.*Rotalia Soldanii* (d'Orb.), var. *nitida*, Reuss, Chapman, 1898, Journ. R. Micr. Soc. pp. 9, 10, pl. ii. figs. 2 a-c.

Very common at Swaffham.

The types of the foregoing 138 species and vars. of the Foraminifera described or referred to in these papers, and also the figured Ostracoda, are now placed in the Woodwardian Museum at Cambridge.

XLVI.—*British Isopoda Chelifera*. By the Rev. Canon
A. M. NORMAN, M.A., D.C.L., LL.D., F.R.S.

OUR knowledge of the group of Isopoda entitled by Sars "Chelifera," and containing the two families Apseudidæ and Tanaidæ, has been greatly extended of late years. With respect to our own fauna no doubt many small species still await discovery in our seas, and it is remarkable that as yet no member of the genus *Typhlotanais* has been met with, although nine belong to the Norwegian fauna. Now, however, when these minute forms have been so fully illustrated by the publication of the classical work of Sars, some of the species will probably be soon added to our fauna. Bate and Westwood recorded seven British Isopoda Chelifera; the number in this paper is twenty-three. The following works have either been published since Bate and Westwood, and have reference to species which are here enumerated, or, if of earlier date, are necessitated by synonymy which is here specially noticed; but many authors who are only once mentioned are referred to in the text and not inserted in the following list.

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- (131) SYE (C. G.).—"Beiträge zur Anatomie und Histologie von *Jæra marina*." Kiel, 1887.
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1. "Preliminary Report of the Scientific Exploration of the Deep Sea in H.M. Surveying-Vessel 'Porcupine' during the Summer of 1869," Proc. Roy. Soc. no. 121 (1870).
2. "Report of Deep-Sea Researches, July, August, and September 1870, in H.M. Surveying-Ship 'Porcupine,'" Proc. Roy. Soc. no. 125 (1870).
3. "The 'Valorous' Expedition: Reports of Dr. Gwyn Jeffreys and Dr. Carpenter," Proc. Roy. Soc. vol. xxv. no. 173 (1876).

ISOPODA CHELIFERA.

Fam. I. Apseudidæ.

Genus 1. APSEUDES, Leach.

1. *Apseudes talpa* (Montagu).

1866. *Apseudes talpa*, Bate & Westwood, (1) vol. ii. p. 148.

1880. *Apseudes talpa*, G. O. Sars, (101) p. 10.

1886. *Apseudes talpa*, Norman & Stebbing, (86) p. 81.

1886. *Apseudes talpa*, G. O. Sars, (103) p. 267, pls. i., ii.

Hab. Guernsey, and among stones, the Fleet, Weymouth (*A. M. N.*). Tidemark, Jersey (*Sinel & Hornell*, 135). Among roots of *Laminaria saccharina* in 7 fath., near the Tan Buoy, Cumbrae, N.B. (*D. Robertson*, 91). Montagu's specimen was taken at Salcombe; and Barlee procured it at Plymouth.

Distrib. Off Capri, Bay of Naples (*A. M. N.*); Sardinian coast (*Prof. Emery*); Adriatic (*Heller* as "*Rhœa Latreillii*"); *Mus. Nor.*, Messina (*G. O. Sars*). The species recorded under this name by Meinert from Denmark was subsequently found by him to be *A. spinosus*.

2. *Apseudes Latreillii* (Milne-Edwards).

1866. *Apseudes Latreillii*, Bate & Westwood, (1) vol. ii. p. 153.

1880. *Apseudes Latreillii*, G. O. Sars, (101) p. 14.

1886. *Apseudes Latreillii*, Norman & Stebbing, (86) p. 82, pl. xvi.

1886. *Apseudes Latreillii*, G. O. Sars, (103) p. 290, pl. v.

Hab. Guernsey; Jersey; mouth of the Yealm, Devon (*A. M. N.*). Moray Firth (*T. Edward* in *Mus. Nor.*). Plymouth (Biol. Lab.: in *Mus. Nor.*). Salcombe, Devon (*Stebbing*, 124).

Distrib. Coast of France (*H. Milne-Edwards*); Naples and Golella (*G. O. Sars*).

This is not *Apseudes Latreillii*, Claus; but appears to be the *Rhœa Latreillii* of Milne-Edwards, and certainly the *Apseudes Latreillii* of Bate and Westw., of G. O. Sars, and of Norman and Stebbing. Professor Claus, in the exhaustive memoirs (16 and 17) on the morphology and physiology of *Apseudes*, named the Adriatic species which he was investigating *Apseudes Latreillii*, M.-Edwards. Immediately after the publication of his first memoir, Mr. Stebbing and myself (86, p. 133) pointed out that Claus's species was not that understood by *A. Latreillii*, and we named this new Adriatic form *Apseudes hastifrons*; and Boas (5), arriving shortly after at the same conclusion, named the same Adriatic form

A. Clausi. In the same year Professor G. O. Sars published his work on the Mediterranean Isopoda Chelifera (103), in which full illustrations were given of a Mediterranean *Apseudes*, which he had previously characterized (101) under the name *A. acutifrons*, G. O. Sars. Professor Claus, replying to the criticisms of Boas on this and other points in his second memoir (17), argued that the Adriatic form he had described was the true *Rhœa Latreillii* of Milne-Edwards, and that it was the same species as *A. acutifrons*, G. O. Sars, which latter name must become a synonym of the former, while the *A. Latreillii* of Bate and Westwood, of Norman and Stebbing, and of Sars must be renamed as *A. Sarsii*, Claus. It is necessary, therefore, to carefully examine the form described by Milne-Edwards. *Rhœa Latreillii*, H. Milne-Edwards, was twice figured by its describer, originally in *Annales des Sci. Nat.* vol. xiii. 1828, p. 292, pl. xiii. A, figs. 1-8, and then again in 'Règne Animal Cuvier. Les Crustacés,' par Milne-Edwards, pl. lxii. fig. 2. A comparison of these figures brings out some important points. In both figures the hand of the second gnathopod is represented as armed with four spines and the wrist with one: in the 'Annales' fig. 2 represents a conspicuous rostrum, and the last segment of the pleon is of considerable length, as long as the three preceding segments; in the larger figure which we find in the 'Règne Animal' the rostrum has the proportions of that of Spence Bate's *Latreillii*, and the large pleon-segment only equals the length of two preceding segments. Taking these facts together, and the general details of the figures as well as the description, it would seem that M.-Edwards's species cannot be *A. acutifrons*, Sars. First, as regards the rostrum, the description "extrémité antérieure se prolonge sur la forme d'un rostre pointu et légèrement recourbée," applies closely to *Latreillii**, but scarcely to *acutifrons*: the last segment of pleon is described as "remarquable par sa longueur"; it is represented in the 'Annales' as equal in length to the three preceding segments, but in Cuvier as equal to only two—in the former case resembling that of *acutifrons*, in the latter that of *Latreillii*. • The fossorial second gnathopods are both described and figured as having four spines on the margin of the hand and one on the carpus: now *acutifrons* has four on the hand and two on the carpus, six in all on these two joints; while *Latreillii* has three spines on the hand and two on the carpus, five in all.

* Henceforward I shall use the term "*Latreillii*" for *Latreillii*, Bate and Westwood.

Thus M.-Edwards's description and figure of this limb does not accord with that of either of the species we are considering: if *acutifrons*, then one of the wrist-spines is omitted; if *Latreillii*, then one of the spines which really belonged to the wrist has been attributed to the hand. The last appears to be the more likely supposition. But it may be that the specimen was an abnormal one, or that *A. Latreillii* of Milne-Edwards was another species, and neither *A. Latreillii* of Bate and Westwood nor *A. acutifrons*. That it is not the latter species I think we may be satisfied, for Milne-Edwards, who describes the spine-formed epimeral process of the first segment of the peræon, could not have entirely omitted, both in his illustration and in his description, the spine-processes at the anterior corners of the cephalon or those on the sides of the segments of the peræon, which are conspicuous in *acutifrons* but absent in *Latreillii*.

Some uncertainty must remain as to whether Milne-Edwards's species is the same as that of Bate and Westwood; but it seems desirable to retain the name for the latter form until this use shall have been proved to be wrong by any future discovery of an *Apseudes* which more closely accords with the figures of Milne-Edwards and found on the French coast.

The second point for consideration is what name the Adriatic species described by Claus as *A. Latreillii*, and subsequently identified by him with *A. acutifrons*, G. O. Sars, ought to bear. Unquestionably the form is remarkably near to that described by Sars, and to this Claus would assign it as a local variety. It differs, however, in some important details, chiefly in the armature of the hand of the second gnathopods. This in *A. acutifrons* is furnished with four long acute spines, but in the Adriatic form with six such spines. I have examined forty specimens of the former, taken by myself at Naples, and six of the latter, given to me by Professor Claus; every Neapolitan example had the four spines and each of the Adriatic specimens six. Now the spines which are in this position I have found in all the *Apseudidæ* examined by me to afford valuable specific characters, and the number in each species to be remarkably constant. There are other minute differences between the two forms; thus, the outer ramus of the uropods in *A. acutifrons* is two-jointed, but in the Adriatic form three-jointed. These two forms, however, agree in a very important character, and differ from other species referred to the genus *Apseudes*, inasmuch as the eye-lobes, which are usually

separable from the cephalon, are here firmly connected to and form a portion of it. The divergence of structure is so remarkable that it appears to me that *A. acutifrons* and *A. hastifrons* ought to be generically separated from their allies; and I would propose for them the name *Apseudopsis*. The synonymy will be:—

(1) *Apseudopsis acutifrons* (G. O. Sars).

1880. *Apseudes acutifrons*, G. O. Sars, (101) p. 15.

1886. *Apseudes acutifrons*, G. O. Sars, (103) p. 295, pl. vi.

(2) *Apseudopsis hastifrons* (Norman & Stebbing).

1884. *Apseudes Latreillii*, Claus, (16) p. 316, pls. i., ii.

1886. *Apseudes hastifrons*, Norman & Stebbing, (86) p. 133.

1886. *Apseudes Clausi*, Boas, (15) p. 109.

1887. *Apseudes Latreillii*, Claus, (17) p. 139, pls. i.-vii.

3. *Apseudes hibernicus*, Walker.

1897. *Apseudes hibernicus*, A. O. Walker, (133) p. 228, pl. xvii. figs. 2-2 d, pl. xviii. figs. 2 e & 2 f, and (134) p. 164 (name only).

Through the kindness of Dr. Scharff I have had an opportunity of examining two specimens of this species which are preserved in the Natural History Museum of Dublin and are referred to and identified with the species by Mr. Walker. These *Apseudes* appear to me to approach nearest to *A. tenuimanus*, G. O. Sars (103, pl. iii.), but the antennal filaments are more numerously jointed, the sides of the segments of the peræon are without the lateral and posterior projections, and the telson is shorter.

Hab. Between tide-marks on Church Island, Valentia, Ireland, where it was taken by Mr. F. W. Gamble.

4. *Apseudes spinosus* (M. Sars).

1864. *Apseudes talpa*, Lilljeborg, (61) p. 9.

1858. *Rhoea spinosa*, M. Sars, "Oversigt over de i den Norske-arktiske Region forekommende Krebsdyr," Christ. Vid. Selsk. Forhand. 1858, p. 30.

1869. *Apseudes talpa*, G. O. Sars, (96) p. 45.

1877. *Apseudes talpa*, Meinert, (70) vol. xi. p. 85 (*fide* Meinert, (71) p. 125).

1880. *Apseudes spinosus*, G. O. Sars, (101) p. 11.

1886. *Apseudes spinosus*, Norman & Stebbing, (103) p. 85, pl. xvii. fig. 1.

1896. *Apseudes spinosus*, G. O. Sars, (105) p. 7, pls. i. & ii.

1896. *Apseudes Kæhleri*, Bonnier, (8) p. 562, pl. xxxi. figs. 1 a-n.

Hab. 'Porcupine' Expedition, 1869, off S.S.W. Ireland, 725 fath. (Stat. 36, lat. 48° 50' N., long. 11° 9' W.).

Distrib. On the Norwegian coast I have dredged it at Drobak, near Christiania, and very abundantly near Lervig in the Hardanger Fiord in 180 fath.; and I am indebted to Herr I. Sparre Schneider for examples from Tromsö. Vadsö, East Finmark (*G. O. Sars*); Bohuslän, Sweden (*Lilljeborg*); Denmark (*Meinert*); Bay of Biscay (*Bonnier*).

5. *Apseudes simplicirostris*, Norman & Stebbing.

1886. *Apseudes simplicirostris*, Norman & Stebbing, (86) p. 91, pl. xviii. fig. 1.

The type and only known specimen of this marked form was taken by the 'Porcupine,' 1869 (Stat. 22, lat. $56^{\circ} 8' N.$, long. $13^{\circ} 34' W.$), about 100 miles directly south of Rockall, in 1263 fath.

6. *Apseudes grossimanus*, Norman.

1870. *Apseudes grossimanus*, Norman, Proc. Royal Soc. no. 125, p. 157 (no description).

1881. *Apseudes grossimanus*, Norman, (84) p. 10 (name only).

1886. *Apseudes grossimanus*, Norman & Stebbing, (86) p. 93, pl. xix.

Hab. 'Porcupine,' 1869, off S.W. Ireland, in 90 fath. (Stat. 6, lat. $52^{\circ} 25' N.$, long. $11^{\circ} 40' W.$).

Distrib. 'Porcupine,' 1870, off coast of Portugal, in 740 fath. (Stat. 17 a, lat. $39^{\circ} 3' N.$, long. $9^{\circ} 39' W.$); and off Sidi Terri, North African coast. I also saw it dredged in the Bay of Biscay when with the 'Travailleur' Expedition in 1880.

Genus 2. SPHYRAPUS, Norman & Stebbing, 1886.

7. *Sphyrapus malleolus*, Norman & Stebbing.

1886. *Sphyrapus malleolus*, Norman & Stebbing, (86) p. 98, pl. xxii. figs. 2, 3.

1896. *Sphyrapus malleolus*, Bonnier, (8) p. 565, pl. xxxi. fig. 1.

Hab. 'Porcupine,' 1869, at two stations (Stat. 22 and 24) to the south of Rockall, in 109 and 1263 fath.

Distrib. 'Porcupine,' 1870, Stat. 17 a, lat. $39^{\circ} 39' W.$, long. $9^{\circ} 39' W.$, in 740 fath., off the coast of Portugal; 'Valorous,' 1875, Stat. 11, lat. $57^{\circ} 11' N.$, long. $37^{\circ} 41' W.$, south of Cape Farewell, Greenland, in 1450 fath. From the 'Caudan' Expedition Bonnier records it from the Bay of Biscay in 650 and 1410 metres.

8. *Sphyrapus tudes*, Norman & Stebbing.

1886. *Sphyrapus tudes*, Norman & Stebbing, (86) p. 99, pl. xxii. fig. 1.

Hab. 'Porcupine,' 1869, Stat. 23 a, lat. 56° 13' N., long. 14° 18' W., to the south of Rockall, in 420 fath.

Fam. II. Tanaidæ.

Genus 1. TANAIS, M.-Edwards.

9. *Tanais Cavolinii*, H. M.-Edwards.

1828. *Tanais Cavolinii*, H. Milne-Edwards in Audouin & Milne-Edwards's Précis d'Entomologie, vol. i. pl. xxix. fig. 1.

1840. *Tanais Cavolinii*, H. Milne-Edwards, Hist. Nat. des Crust. vol. iii. p. 141, pl. xxxi. fig. 6.

1842. *Tanais tomentosus*, Kröyer, (52) p. 183, and Voyage en Scandinavie &c. (1849 P) pl. xxvii. figs. 2 a-g.

1843. *Crossurus vittatus*, Rathke, (89) p. 39, pl. i. figs. 1-7.

1866. *Tanais vittatus*, Bate & Westwood, (1) vol. ii. p. 125.

1875. *Tanais vittatus*, Macdonald, Trans. Linn. Soc. ser. 2, vol. i. (Zoology) p. 67, pl. xv.

1881. *Tanais vittatus*, Harger, (37) p. 418, pl. xiii. figs. 81, 82.

1896. *Tanais tomentosus*, G. O. Sars, (105) p. 12, pl. v.

1897. *Tanais Cavolinii*, A. Dollfus, (25) p. 207.

1898. *Tanais Cavolinii*, A. Dollfus, (26) p. 35.

Hab. Tide-marks among weeds, Farland Point, Cumbræ, N.B., and Tobermory in the Isle of Mull (*A. M. N.*); May Island, Firth of Forth, and Dunbar (*Henderson*). Bate & Westwood record it from Berwick (*Dr. Johnston*) and Polperro, Cornwall (*Laughrin*); Jersey (*Köhler*); Netley Hospital Pier and Alum Bay, Isle of Wight (*Macdonald*).

Distrib. It is found on the coast of Norway (*Rathke &c.*); Öresund (*Kröyer*); West France (*Chevreux*); Mediterranean, in many places (*Chevreux*, fide *Dollfus*); Azores (*Th. Barrois*); Greenland (*Hansen*).

M. A. Dollfus has described several closely allied species from the Mediterranean—one with the uropods three-jointed, which is the species of which the above are synonyms, the true *T. Cavolinii* of Milne-Edwards; and three others which agree in having the uropods four-jointed and differ from each other in slight particulars. It is probable that the form which Prof. G. O. Sars has described in his memoir on the Mediterranean Isopoda Chelifera (103, pl. ix. figs. 1-3) is referable to *T. Chevreuxi*, A. Dollfus. It differs from *T. Cavolinii* (= *T. vittatus*) in having the body more slender and the uropods four-jointed.

This species may hereafter be found on our southern coasts, and it is possible that the "very slender form" which

the late Mr. D. Robertson sent to Spence Bate, which that author at first thought a distinct species and named in MS. *T. hirticaudatus*, may really have been that now known as *T. Chevreuxi*.

10. *Tanais Dulongii* (Audouin).

1866. *Tanais Dulongii*, Bate & Westwood, (1) vol. ii. p. 129.

This species is at present unknown to me, and I am unable to throw any light upon it.

Bate and Westwood write:—"The only individuals which we have seen were sent to us from Polperro by Mr. Laughrin." In the "Last Report of Dredging among the Shetland Isles" I recorded this species from "St. Magnus Bay, rare." I have now searched in vain in my collection for the specimens, and can neither find it or any other Shetland form which could have been confounded with it. I know that many of my Tanaidæ were years ago dried up, and this form was probably among them.

Genus 2. LEPTOCHELIA, Dana.

11. *Leptochelia Savignii* (Krøyer).

1842-3. *Tanais Savignii*, Krøyer, (52) p. 168, pl. ii. figs. 1-12, ♂.

1842-3. *Tanais Edwardsii*, Krøyer, (52) p. 174, pl. ii. figs. 13-19, ♀.

1866. *Leptochelia Edwardsii*, Bate & Westwood, (1) vol. ii. p. 134, ♂.

1881. *Leptochelia algicola*, Harger, (37) p. 423 (meum exemplum illi transmissum, nec Americæ exempla).

1881. *Puratanais Savignii*, Delage, (20) p. 134, pl. xi. figs. 1-8.

1880. *Leptochelia Savignii*, G. O. Sars, (101) p. 25.

1886. *Leptochelia Savignii*, G. O. Sars, (103) p. 326, pl. ix. figs. 4-8.

1898. *Leptochelia Savignii*, A. Dollfus, (26) p. 41 and woodcuts.

Hab. The specimens described by Bate and Westwood were found by me among *Zostera* between tide-marks in Belgrave Bay, Guernsey. Since the publication of that work it has been recorded from Saik (*Kæhler*) and Jersey (*Sinel and Hornell*).

Distrib. I have procured it at Naples. Gourret records it from Marseilles; Sars from Trieste, Spezia, Messina, and Syracuse; and Chevreux and Dollfus also from many places in the Mediterranean. The former of these has proved its range on the Atlantic coast from Brittany to Senegal. Azores (*Th. Barrois*). Krøyer's type specimens were from Madeira.

12. *Leptochelia dubia* (Kröyer).

- 1842-3. *Tanais dubius*, Kröyer, (52) p. 178, pl. ii. figs. 20-22.
 1878. *Paratanais algicola*, Harger, (35) p. 377.
 1879. *Paratanais algicola*, Harger, (36) p. 162.
 1870. *Tanais Savignii*, Dohrn, (21) p. 293, pls. xi., xii. figs. 6-19.
 1851 (?). *Leptochelia algicola*, Harger, (37) p. 421, pl. xii. fig. 3, pl. xiii. figs. 83-86.
 1880. *Leptochelia dubia*, G. O. Sars, (101) p. 26.
 1886. *Leptochelia dubia*, G. O. Sars, (103) p. 317, pls. x., xi.
 1893. *Leptochelia algicola*, A. Dollfus, (26) p. 44 and woodcuts.

Hab. Jersey; Birterbuy Bay, Ireland, 1874; Falmouth Harbour, 1884 (*A. M. N.*); Valentia, Ireland, 1½ fath., mud (*A. O. Walker*).

Distrib. Mediterranean (*Dohrn, Sars*); on the Atlantic coast it has been procured by Chevreux (fide *Dollfus*) from Brittany to Senegal and Teneriffe. Harger has found it on the N.E. coast of America. Kröyer's types were from Brazil, and Dollfus has rejected his name on account chiefly of the distance of that locality; but the range of the species is known to be very extensive, and until the Brazilian form is proved to be something different it is surely preferable to retain Kröyer's name.

Genus 3. ALAOTANAIS, Norman & Stebbing.

13. *Alaotanaïs serratispinosus*, Norman & Stebbing.

1886. *Alaotanaïs serratispinosus*, Norman & Stebbing, (86) p. 113, pl. xxiii. fig. 2.

Hab. 'Porcupine,' 1869, dredged in two places between Ireland and Rockall (Stats. 19 and 30), in 1360 and 1380 fath.

Distrib. 'Valorous,' 1875, Stat. 15, lat. 56° 11' N., long. 37° 41' W., at the depth of 1450 fath.

14. *Alaotanaïs lævispinosus*, Norman & Stebbing.

1886. *Alaotanaïs lævispinosus*, Norman & Stebbing, (86) p. 114, pl. xxiv. fig. 11.

Hab. The type and only known specimen was dredged by the 'Porcupine,' 1869, off Valentia, S.W. Ireland, in 370 fath. (Stat. 1).

Genus 4. PARATANAIS, Dana.

15. *Paratanais Batei*, G. O. Sars.

1855. *Tanais Savignii*, Gosse, Manual Marine Zoology, vol. i. p. 137 (not *T. Savignii*, Kröyer).

1866. *Paratanais forcipatus*, Bate & Westwood, (1) vol. ii. p. 136 (not *Tanais forcipatus*, Lilljeborg).

1880. *Paratanais Batei*, G. O. Sars, (101) p. 32.

1886. *Paratanais Batei*, G. O. Sars, (103) p. 333, pl. xiv. figs. 1-3.

1896. *Paratanais Batei*, G. O. Sars, (105) p. 16, pl. vii.

Hab. Falinouth Harbour, 1884, Plymouth, 1889 (*A. M. N.*). It has been recorded from Sark (*Kæhler*); tide-marks, Jersey (*Sinel and Hornell*); Cumbrae, Firth of Clyde (*D. Robertson*); Arran, N. B.; Loch Fyne and the Firth of Forth (*T. Scott*). Bate and Westwood gave Banff (*T. Edward*).

Distrib. Spezia in the Mediterranean, in 6-10 fath. (*G. O. Sars*); Saint-Jean-de-Luz, S.W. France (*Dollfus*); several places in West Norway, at roots of *Laminaria* (*G. O. Sars*).

Genus 5. LEPTOGNATHIA, G. O. Sars.

16. *Leptognathia longiremis* (Lilljeborg).

1864. *Tanais longiremis*, Lilljeborg, (61) p. 19.

1876. *Tanais islandicus*, G. O. Sars, (99) p. 346.

1880. *Leptognathia longiremis*, G. O. Sars, (101) p. 41.

1885. *Leptognathia longiremis*, G. O. Sars, (104) p. 79, pl. vii. figs. 17-28.

1896. *Leptognathia longiremis*, G. O. Sars, (105) p. 27, pl. xii.

1893. *Leptognathia longiremis*, T. Scott, (116) p. 220.

Hab. This species has been taken by Mr. Thomas Scott on both sides of Scotland—on the west in Loch Fyne, on the east in the Moray Firth and Firth of Forth.

Distrib. In Norway I have dredged it in the Hardanger Fiord, off Lervig, in 150-180 fath.; and in East Finmark in 110-125 fath. in the Varanger Fiord, and in Klosterelv Fiord in shallow water. Other localities are:—off Reykjavik, Iceland (*G. O. Sars*), Denmark (*Meinert*), Greenland (*Hansen*).

Hansen (31) describes and figures a Greenland *Leptognathia* which he considers to be *L. longiremis* of Lilljeborg, but doubtfully refers to it the *L. longiremis* of Sars. The Greenland form has the hand of the first gnathopod less robust and without the characteristic serration of the outer margin of the finger, and the uropods three-jointed, the first joint markedly longer than the rest of the limb, the terminal joint minute.

17. *Leptognathia Lilljeborgi*, Stebbing.

1891. *Leptognathia Lilljeborgi*, Stebbing, (125) p. 328, pl. xvi.

1898. *Leptognathia Lilljeborgi*, T. Scott, (116) p. 219.

Hab. The type specimens were found by Mr. Stebbing in

the sands at Lee and Woolacombe, North Devon. Mr. T. Scott has met with it in several places in the Firth of Forth.

Mr. Scott writes of this species:—" *Leptognathia Lilljeborgi* appears to be somewhat out of place among the species of that genus described by Sars; these all have the 'superior antennæ in the female distinctly 4-articulated,' whereas in this one the fourth joint is described as 'quite rudimentary.' In the specimens from the Firth of Forth I have been unable to satisfactorily make out a fourth joint; in one or two instances, when there was the appearance of a fourth joint, examination with a 'higher' objective showed that the appearance was produced by the approximation of the bases of the subterminal setæ. For this reason I was inclined at first to consider the species as a member of the genus *Typhlotanais*, the females of which have the superior antennæ 3-articulate; but as the general structure of the antennæ in the male and female, together with the form of the chelæ, do not fit in well with either genus, it is perhaps better to leave this Isopod where it is at present. In the female the first joint of the superior antennæ is long, but the other joints are short, and the second appears to be hinged to the first joint, for in some of my specimens the short end-joints bend over at nearly right angles to the first, as if the antennæ were being used as a grasping-organ."

I have written to Mr. Stebbing to ask his present views as to this species. With regard to the antennæ he writes:—"In the upper antennæ the little fourth joint about which Scott is doubtful is quite distinct under a quarter-of-an-inch power. It is a stumpy little articulus, not a triangle such as could be represented by the meeting of two setules." As compared with *L. longiremis* "the differences are considerable. The upper antennæ, as Scott has noticed, are strikingly unlike. The thumb of the first gnathopods and the tuberculation of the fingers do not at all agree, and the last peræopods are also rather strikingly unlike. As to the uropods you will notice that in my species the second joint of the inner ramus is longer than the first, and the reverse in Sars's figure. The apical part of the last pleon-segment is a little differently shaped in the two species, and in *L. longicornis* there is a denticle on each side of which I find not the slightest trace in *L. Lilljeborgi*. The latter species in the female appears to be much smaller than in the former. I incline to agree with Scott that it looks very like a linking species between *Typhlotanais* and *Leptognathia*." (Stebbing, *in litt.*)

18. *Leptognathia brevimana* (Lilljeborg).1864. *Tanais brevimanus*, Lilljeborg, (61) p. 22.1880. *Leptognathia brevimana*, G. O. Sars, (101) p. 42.1886. *Leptognathia brevimana*, G. O. Sars, (103) p. 350, pl. xv. figs. 7-13.1896. *Leptognathia brevimana*, G. O. Sars, (105) p. 29, pl. xiii. fig. 3.1898. *Leptognathia brevimana*, T. Scott, (116) p. 220.

Hab. Off Valentia, Ireland, 1870 (*A. M. N.*); Firth of Forth (*T. Scott*); Moray Firth (*T. Scott and F. G. Pearcey*).

Distrib. Sars says that it occurs all along the coast of Norway from Christiania Fiord to Vadsö. In the Mediterranean he procured it at Messina. Bohuslän, Sweden (*Lilljeborg*); coast of Denmark (*Meinert*); Brittany (*Chevreux*, fide *Dollfus*).

19. *Leptognathia rigida* (Bate & Westwood).1866. *Paratanais rigidus*, Bate & Westwood, (1) vol. ii. p. 141.1880. *Leptognathia rigida*, G. O. Sars, (101) p. 45.

Hab. The type specimen described by Bate and Westwood was dredged at the roots of *Laminaria saccharina*, near Cumbrae in the Firth of Clyde, by the late Mr. D. Robertson, in 7-8 fath. St. Magnus Bay, Shetland, 1867 (*A. M. N.*): so recorded (83); but I no longer have the specimen, and thus cannot again determine it.

20. *Leptognathia breviremis* (Lilljeborg).1864. *Tanais breviremis*, Lilljeborg, (6) p. 21.1880. *Leptognathia breviremis*, G. O. Sars, (101) p. 42.1896. *Leptognathia breviremis*, G. O. Sars, (105) p. 28, pl. xiii. fig. 1.

Hab. This species was found by me in Plymouth Harbour in 1889. Loch Fyne, Firth of Forth, and Moray Firth (*T. Scott*).

Distrib. Bohuslän, Sweden (*Lilljeborg*); Kattegat (*Meinert*). In Christiania Fiord in 20-60 fath., and in several places in south and west of Norway, as far north as Kvalö on the Nordland coast (*G. O. Sars*).

Genus 6. TANAOPSIS, G. O. Sars.

21. *Tanaopsis laticaudata*, G. O. Sars.1880. *Leptognathia laticaudata*, G. O. Sars, (101) p. 43.1886. *Leptognathia laticaudata*, G. O. Sars, (103) p. 353, pl. xv. figs. 14-17.1896. *Tanaopsis laticaudata*, G. O. Sars, (105) p. 32, pl. xiv. fig. 1.

Hab. I took this species in some abundance in Birterbuy Bay, West Ireland, in 1874, and subsequently near Cumbrae

in the Firth of Clyde, where also it has been found by Mr. D. Robertson. Gair Loch in Loch Fyne, Firth of Forth, and Moray Firth (*T. Scott*).

Distrib. Naples and Messina, and in a few places on the west of Norway in 6–20 fath. (*G. O. Sars*).

Genus 7. *STRONGYLURA*, G. O. Sars.

22. *Strongylura arctophylax*, Norman & Stebbing.

1886. *Strongylura arctophylax*, Norman & Stebbing, (86) p. 116, pl. xxiv. fig. 3.

Hab. The type and only known specimen was procured in the 'Porcupine' dredgings of 1869 at Stat 30, lat. $56^{\circ} 24' N.$, long. $11^{\circ} 49' W.$ (that is, between Ireland and Rockall), in 1380 fath.

Genus 8. *PSEUDOTANAIS*, G. O. Sars.

23. *Pseudotanaïs forcipatus* (Lilljeborg).

1864. *Tanaïs forcipatus*, Lilljeborg, (61) p. 16.

1880. *Pseudotanaïs forcipatus*, G. O. Sars, (101) p. 46.

1896. *Pseudotanaïs forcipatus*, G. O. Sars, (105) p. 40, pl. xvii. fig. 1.

Hab. Tarbert Bank in Loch Fyne; Guillam Bank in Moray Firth (*T. Scott*); Smith Bank, Moray Firth (*F. G. Pearcey*, fide *Scott*).

Distrib. Klosterelv Fiord, East Finmark, which is close upon the frontiers of Russia (*A. M. N.*). Sars has found it "along the whole Norwegian coast, as far north as Kvalö." Bohuslän, Sweden (*Lilljeborg*); Öresund, Denmark (*Meinert*).

This is not *Paratanaïs forcipatus*, Bate and Westwood, for which see under *Paratanaïs Batei*, G. O. Sars.

I add a list of North-Atlantic and Arctic Chelifera, which may prove useful to students, as supplying them with information respecting our present knowledge of the northern species of these Crustacea, and references where descriptions of them may be found.

Isopoda Chelifera of North Atlantic and Arctic Oceans not known in British Seas.

Apseudes uncidigitatus, Norman & Stebbing (86).—Mediterranean.

— *obtusifrons*, Nor. & Stebb. (86).—Near Gibraltar.

- Apseudes echinatus*, G. O. Sars (101, 103), = *A. lunarifrons*, Nor. & Stebb. (86).—Mediterranean.
- *gracilis*, Nor. & Stebb. (86).—North Atlantic and Davis Strait.
- *tenuimanus*, G. O. Sars (101, 103).—Mediterranean.
- *robustus*, G. O. Sars (101, 103).—Mediterranean.
- Apseudopsis acutifrons*, G. O. Sars (101, 103).—Mediterranean.
- *hastifrons*, Nor. & Stebb. (86, p. 133), = *A. Latreillii*. Claus (16, 17), = *A. Clausii*, Boas (5).—Adriatic.
- Parapseudes lutifrons* (Grube), G. O. Sars (101, 103).—Mediterranean and Adriatic.
- Sphyrapus anomalus*, G. O. Sars (96, 101, 105), Nor. & Stebb. (86).—Norway and between Iceland and Jan Mayen; Kara Sea (Hansen, 31).
- *scrratus*, G. O. Sars (101, 104).—Between Iceland and Norway and near Spitsbergen.
- Tanais Grimaldii*, A. Dollfus (25).—Azores.
- *Chevreuxi*, A. Dollfus (26) = ? *T. Cavolinii*, G. O. Sars (101, 103), nec *T. Cavolinii*, M.-Edw.—Mediterranean and Adriatic (Heller).
- *tetudinicola*, A. Dollfus (26).—Mediterranean.
- Heterotanais algericus*, A. Dollfus (26).—Mediterranean.
- *provincialis*, A. Dollfus (26).—Mediterranean.
- *Örstedii* (Krøyer) (52 †), = *T. curculio*, Krøyer, ♂ (52), = *T. baliticus*, Fr. Müller, ♀, and *T. rhynchites*, Fr. Müller, ♂ ♀.—Greifswalde, Prussia; Norway (G. O. Sars, 101, 105); Baltic and Sweden (Lilljeborg, 61); Kiel (Blanc) §.
- *anomalus*, G. O. Sars (101, 103).—It was assigned as a second form of the male of *Tanais dubius* by Dohrn (21).—Mediterranean.
- *limicola* (Harger), = *Leptochelia limicola*, Harger (35, 37).—N.E. America and Greenland (Hansen, 31).
- Leptochelia neapolitana*, G. O. Sars (101, 103).—Mediterranean.
- *rapax*, Harger (36, 37).—N.E. America.
- *flum* (Stimpson, 128), Harger (36, 37).—N.E. America.
- *corsica*, A. Dollfus (26).—Mediterranean.

* Grube (A. E.), 'Die Insel Lussin und ihre Meeresfauna,' 1864, p. 75.

† Figured by Krøyer, in Gaimard, Voyage en Scandinavie &c. pl. xxxi. fig. 3, ♀, pl. xxx. fig. 4 (*T. curculio*), ♂.

‡ Fr. Müller, Archiv für Naturges. Jahr. 18, Bd. i. pp. 88, 89, pl. iv.

§ Blanc (H.), "Contributions à l'Hist. nat. des Asellotes Hétéropodes: Observations faites sur la *Tanais Örstedii*," Recueil Zoologique Suisse, vol. i. pt. 2 (1884).

- Alaotanaïs hastiger*, Nor. & Stebb. (86).—Entrance to Davis Strait.
- Puratanais atlanticus*, A. Dollfus (25).—Azores.
- Typhlotanaïs tenuimanus* (Lilljeborg) (61), G. O. Sars (101, 105).—Norway.
- *æquiremis* (Lilljeborg) (61), G. O. Sars (101, 105), = *Tanaïs depressus*, G. O. Sars (96).—Sweden (*Lilljeborg*); Norway (*Lilljeborg and Sars*).
- *brevicornis* (Lilljeborg) (61), G. O. Sars (101, 105).—Norway (*Lilljeborg and Sars*); Denmark (*Meinert*, 71).
- *finmarchicus*, G. O. Sars (101, 105).—East Finmark.
- *assimilis*, G. O. Sars (101, 105).—Norway.
- *tenuicornis*, G. O. Sars (101, 105).—Norway.
- *microcheles*, G. O. Sars (101, 105).—Norway.
- *cornutus*, G. O. Sars (100, 101, 104, 105).—Between Beeren Island and Finmark and Norway.
- *penicillatus*, G. O. Sars (101, 105).—Norway.
- *messinensis*, G. O. Sars (101, 105).—Mediterranean.
- *spiniventris*, A. Dollfus (25).—Azores.
- *Richardi*, A. Dollfus (25).—Azores.
- *longimanus*, A. Dollfus (25).—Azores.
- Leptognathia filiformis* (Lilljeborg) (61).—Sweden (*G. O. Sars*, 101, 105); Norway (*Meinert*, 71); Denmark.
- *manca*, G. O. Sars (101, 105).—Norway.
- *gracilis* (Krøyer) (52), figured 'Voyage en Scandinavie &c.' pl. xxxi. fig. 4.—Spitsbergen and Norway (*J. Hansen*, 31); Kara Sea.
- *graciloides* (Lilljeborg) (61).—Sweden.
- *cæca* (Harger) (35, 36, 37).—N.E. America.
- *crassimana*, A. Dollfus (26).—Brittany.
- Pseudotanaïs macrocheles*, G. O. Sars (101, 105).—Norway.
- *Lilljeborgii*, G. O. Sars (101, 105).—Finmark.
- *mediterraneus*, G. O. Sars (101, 105).—Mediterranean.
- *affinis*, Hansen (71).—Kara Sea.
- *crassicornis*, Hansen (71).—Kara Sea.
- Cryptocope abbreviata*, G. O. Sars (94, 101, 105).—Norway.
- *vöringii*, G. O. Sars (94, 101, 104).—To the west of Norway in the ocean.
- *arctica*, Hansen (31, 32).—Kara Sea and Greenland.
- Haplocope angusta*, G. O. Sars (101, 105).—Norway.
- ? *abyssorum*, A. Dollfus (25).—Azores.

Strongylura cylindrica, G. O. Sars (101, 105).—Norway.

Anarthura simplex, G. O. Sars (101, 105).—Norway, West France
(*A. Dollfus*, 26).

Mesotanaïs dubius, A. Dollfus (25).—Azores.

Neotanaïs Edwardsi, A. Dollfus (27).—Bay of Biscay.

Tanaella unguicillata, Nor. & Stebb. (86).—Lat. 49° 7' N., long.
10° 57' W., which is a little south of the British Area as
defined by me.

XLVII.—*Note on the Harvest-Mice of the Palæarctic Region.*
By G. E. H. BARRETT-HAMILTON.

VERY little is known of the variations in colour, size, or proportions of the harvest-mice of different parts of the Palæarctic Region. It could, however, hardly be doubted that some such variations exist in an animal which is distributed over so wide an extent of country, occurring as it does from Great Britain to the coast of China. Accordingly we find that specimens in the British Museum collection from North-western Fokien, Western Hungary, and England are readily distinguishable from each other, and it is plain that each of these series represents a distinct local race or sub-species.

As regards nomenclature, the harvest-mouse was first described by Pallas, who, in 1779, gave to it the name of *Mus minutus*, but did not localize his type. As, however, he alludes to Siberian specimens as differing from those of which he writes under the heading of *M. minutus*, it seems clear that this name must be used for the harvest-mice of Continental Europe, and that all other names given to European harvest-mice (except, as shown below, that of *M. messorius* for the harvest-mouse of Great Britain) must rank as synonyms of it until it can be shown that more than one form of harvest-mouse exists in Continental Europe.

The name *messorius* of Kerr must stand for the British form, while *M. pygmaeus* of Milne-Edwards, from Eastern Asia, is another subspecies. Lastly, I propose the name of *ussuricus* for the Northern Siberian form, of which the British Museum possesses a specimen from Ussuri in the Coast Province of Eastern Siberia (no. 91. 6. 29. 1).

The following are the forms which may at present be distinguished. They may be conveniently regarded as sub-species of *Mus minutus*.

1. *Mus minutus messorius* *.

Mus messorius, Kerr, Animal Kingdom, p. 230 (1792).

Type locality. Hampshire, England.

Summer pelage orange-red above, brightest on the rump and lighter on the sides, and always marked off by a clear line of demarcation from the pure white of the under surface. Winter pelage not so bright as that of summer. Colour of underside and line of demarcation as in summer.

The following are the maximum, mean, and minimum dimensions of fifteen males and nine females, all of which were measured in the flesh, and which form part either of my own or of the British Museum collection:—

		Head and body. mm.	Tail. mm.	Hind foot. mm.	Ear. mm.
15 males	{ Maximum..	65	67	15	9
	{ Mean.....	59.1	57.1	14.2	8.1
	{ Minimum..	56	50	12	7
9 females	{ Maximum..	60	57	14.5	9.5
	{ Mean.....	56.8	53	13.9	8.3
	{ Minimum..	51	49	13	7

It will be noted that the length of the tail is usually, but by no means always, less than that of the head and body.

Of the young, it is stated by Mr. J. E. Harting, from observations on individuals born and kept in captivity ('Zoologist,' Nov. 1895, pp. 420, 421), "that even when almost as large as the old ones they were not nearly so red. Indeed, until the beginning of December they resembled a house-mouse in colour. About that time, however, they began to change visibly, the hinder quarters from the root of the tail upwards becoming rufous before any other portion of the body." A family of young harvest-mice set up in the Tring Museum are, however, as bright as their parents in the same case.

French specimens seem to agree in colour with those of England, judging by the descriptions and figures of French

* This form, though not the typical one, is here put first because the information at my disposal relating to it is fuller than in the case of *M. minutus*, so that instead of comparing *M. messorius* with *M. minutus*, as I should strictly do, I am forced to reverse the comparison.

As shown by Mr. Oldfield Thomas (Ann. & Mag. Nat. Hist. (5) iv. p. 347, 1879), Kerr's use of the name *messorius* for the harvest-mouse of England clearly antedates that of Shaw (Gen. Zool. vol. ii. pt. 1, p. 62, 1801), to whom the first use of the name is generally attributed in books.

writers (see Trouessart, 'Les Petits Mammifères de la France,' with a coloured plate of this species).

2. *Mus minutus typicus*.

Mus minutus, Pallas, Nov. Spec. pp. 96 & 345 (1779).

This name antedates all other names applied to European harvest-mice, and of which I have given a list at the end of this paper. They are therefore synonyms of it as applied to the whole of Europe. Should it be found, however, that more than one subspecies of harvest-mouse exists in Europe, this name must be restricted to that of the North, while the other and later names must be applied to the various other species according to the localities in which they occur.

Six examples from Western Hungary, collected in August, 1893, are singularly unlike British specimens, as they entirely lack the orange-red of the latter except on the rump, and are instead of a light sepia-brown on the upper surface, lighter on the sides, and shading to orange-red on the rump. The under surface is, like that of the British specimens, pure white, with a clearly marked line of demarcation separating the colours of the upper and lower surfaces.

The proportionate lengths of the feet and tail, so far as can be ascertained from the dried skins, are similar to those of *M. messorius*.

A specimen from Holstein (British Museum Collection, no. 47. 4. 5. 2) appears to be intermediate in character between those of Hungary and England, the whole of the upper surface being rusty red; but the skin is an old one, badly preserved and untrustworthy for comparison.

3. *Mus minutus pygmæus*.

Mus pygmæus, Milne-Edwards, Recherches Mamm. p. 291 & pl. xliii. (1874).

Three specimens of this form from North-west Fokien have recently been added to the British Museum collection through the kindness of the collector, Mr. J. de La Touche. In the colour of the upperside these mice cannot be distinguished from the Hungarian specimens, but the tail is very much longer, the underside dirty white, and the line of demarcation between the colours of the upper and under sides not very clearly marked. These specimens have only a trace of the red rump of *M. minutus*. They were collected at Kuatun, N.W. Fokien, in April 1898.

The dimensions, given in inches on two of the labels, and converted into millimetres, are as follows :—

	Head and body. mm.	Tail. mm.
♂, 12th April, 1898	55	76
(Unsexed), 27th April, 1898	58	61

showing that the length of the tail exceeds that of the body.

The dimensions of an adult female, one of Père David's specimens from Tibet, and now in the Paris Museum, were found by Mr. Oldfield Thomas to be: head and body 56·5, tail 57, hind foot 14, ear 7·2.

The subspecies was originally described by Milne-Edwards from specimens collected by Père David in the Province of Sé-tchuan*, in Eastern Tibet.

4. *Mus minutus ussuricus*, subsp. n.

The type specimen was collected by Messrs. Dörries at Ussuri, in the Coast Province of Eastern Siberia, and is no. 91. 6. 29. 1 of the British Museum collection. In its coloration it is far darker on the upper surface than *Mus minutus*, and the red colour on the rump is far duller; as in *minutus*, the dark colour of the upper surface becomes lighter on the flanks, but, unlike *minutus*, there is no distinct line of demarcation and the white colour of the underside, instead of being pure, is washed with dirty yellow. The specimen is large and seems to about equal in size a house-mouse, *Mus musculus*.

The dimensions of the dried skin are as follows:—

	mm.
Head and body	78
Tail	62
Hind foot	12

The cranial and dental characters are not distinctive from those of other subspecies.

The description of *Mus minutus flavus*, as given by Kerr ('Animal Kingdom,' p. 232, 1792), prevents me from identifying my new mouse with this form, which, according to Kerr, "is elegantly yellowish coloured on the upper parts, and pure white on the under parts of the body." He adds that it "Inhabits Siberia.—This variety is exceedingly beautiful."

The subspecific identity of the mice to which the following names were applied must for the present remain uncertain,

* At page 291 the province is called Sé-tchuan; under the plate it is called Moupin.

until such time as specimens from the districts to which they refer are available. There can be no doubt that they all have reference to harvest-mice.

Mus campestris, Desmarest, Mamm., Suppl. p. 543 (1822) [giving a name to the "Mulot nain" of Geoffroy & Cuvier].

"Mulot nain," Geoffr. & Cuv. Mamm. xxxiii* & plate (Oct. 1821).

"Rat des Moissons," *op. cit.* lxiv* (Nov. 1830).

Mus pumilus, Geoffr. & Cuv. *op. cit.* Tab. Gén. et Méth. (1842).

France.

Mus minutus flavus, Kerr, Animal Kingd. p. 232 (1792).

"Inhabits Siberia" (see above).

Mus soricinus, Hermann, Obs. Zool. i. p. 57 (1804).

Neighbourhood of Strasburg. Is figured by Shaw (Gen. Zool. iv. 1, p. 133) with a very shrew-like appearance.

Mus pendulinus, Hermann, *op. cit.* p. 61 (1804).

Germany.

Mus parvulus, Hermann, *op. cit.* p. 62 (1804).

Strasburg, Germany.

Mus pratensis, Ockshay, Nov. Acta Leopold.-Carol., xv. 2, p. 243 (1831).

Western Hungary. The figure and description are those of a harvest-mouse. This name antedates *Mus arundinaceus* of Petenyi (*vide infra*).

Micromys agilis, Dehne, Hofössnitz, p. 16 (1841).

Dresden, Germany.

Mus meridionalis, Costa, Ann. dell' Accad. degl. Asp. Nat. Nap. vol. ii. p. 33 (1844).

Naples, Italy. The description has been shown by Dr. Forsyth Major (Atti Soc. Tosc. Sci. Nat. vol. iii. p. 129, 1884) to be based on a specimen of *Mus minutus*.

Mus arundinaceus (Petenyi), Chyzer, Rel. Pet. Termes-Fuzetek N., p. 91 (1881).

Buda-Pesth and Western Hungary. The type has been lost, but Mr. Oldfield Thomas has been informed, in a letter from Dr. Julius Madarász, that it was a harvest-mouse, a conclusion to which I had already come in the 'Zoologist' for May 1896, p. 181.

XLVIII.—*On the South-Pacific Fishes of the Genus Callanthias.* By G. A. BOULENGER, F.R.S.

THE genus *Callanthias* was established by Lowe in 1839 for a remarkable Perciform fish inhabiting the Mediterranean and neighbouring parts of the Atlantic—*C. peloritanus*, Cocco. A second species was discovered by Mr. Morton Allport off the coast of Tasmania and described by Günther in 1876 under the name of *C. Allporti*: one of the types is figured in the first volume of the new 'Catalogue of Fishes,' pl. xv., and I can answer for the perfect accuracy of the figure, with this restriction—that the tail-fin of the specimen is possibly injured; the absence of a filamentous prolongation of the outer rays of the caudal is therefore a peculiarity which I shall abstain from mentioning among its specific characters. A third species, of which specimens were obtained near Juan Fernandez by Dr. L. Plate, has been added quite recently by Steindachner, under the name of *C. Platei* ('Fauna Chilensis,' Fische, p. 284, pl. xv.).

From the description and figure it is evident that *C. Platei* differs from *C. Allporti* by the feebler dentition, the feebler lower opercular spine, the much shorter dorsal and anal rays, and the more slender caudal peduncle. In *C. Allporti* the last dorsal spine measures $\frac{2}{3}$ the length of the head and the longest soft rays are fully as long as the head; the third anal spine measures $\frac{2}{3}$ the length of the head; the caudal peduncle is as deep as long. In *C. Platei* the last spine is little more than $\frac{1}{2}$ the head, and the soft rays are not much longer; the third anal spine is about $\frac{1}{2}$ the head, and the caudal peduncle is $1\frac{1}{2}$ as long as deep. These characters are certainly sufficient to justify the specific distinction of the Tasmanian and Chilian fishes.

Almost simultaneously with Steindachner's description there appeared, in both 8vo and 4to editions, E. R. Waite's Report on the Fishes collected off the coast of New South Wales on H.M.C.S. 'Thetis' (Sydney, 1898), in which is figured, on plate ii., under the name of *Callanthias Allporti*, a fish which differs greatly from the true *C. Allporti*, and seems to me to be identical with *C. Platei*. Waite does not describe the fish, only remarks:—"Our specimens do not wholly agree with the published descriptions of the species, but critical comparisons are reserved for the more technical treatise previously announced." In view of this forthcoming work I therefore wish to point out that the differences which Mr. Waite appears to treat so lightly certainly indicate

specific diversity, and at the same time to draw attention to the interesting probable fact of yet another Perciform fish being common to the coasts of Eastern Australia and Chili, like *Gilbertia semicincta* and *Caprodon longimanus*, which were likewise obtained by both the 'Thetis' and the Plate expeditions.

At any rate, should, on direct comparison, the New South Wales and Juan Fernandez specimens prove to be specifically distinct, which I doubt, these species would be more nearly related to each other than to *C. Allporti*.

It is much to be desired that in future a closer comparison be instituted between the fishes of the western and eastern parts of the South Pacific than has hitherto been the case.

XLIX.—*A new Stridulating Theraphosid Spider from South America.* By R. I. Pocock.

UP to the present time, with the exception of the Trinidad *Psalmopæus Cambridgii*, the stridulating Theraphosid Spiders have been recorded only from tropical Africa and the Oriental Region. The species that I here record therefore is of considerable interest, as being a genuine South-American Theraphosid with a stridulating-organ lodged between the coxæ of the palp and of the first pair of legs. In position, but not in structure, this organ resembles that of the tropical African genera of Eumenophorinæ (*Phoneyusa*, *Hystero-crates*, &c.). The organ, however, is much less specialized than in these last and has not the same taxonomic importance, being apparently only of generic value.

CITHAROSCELUS, gen. nov.

Belonging to Simon's section Homœommateæ of the subfamily Theraphosinæ (Aviculariinæ), and allied both to *Homœomma* and *Phryxotrichus* in size and spacing of the eyes, differing from the latter in having the labium distally covered with close-set spinules, and from both in possessing a stridulating-organ lodged between the coxa of the palp and that of the first leg. This organ consists of an irregular cluster of about a dozen or more longer and shorter red, pubescent, incrassate but apically pointed, nearly horizontal bristles above the suture on the coxa of the first leg, and a few similar but smaller bristles below the suture. On the posterior side of the coxa of the palp there are about nine similar bristles.

Citharoscelus Kochii, sp. n.

? *Mygale rosea*, Walck., C. Koch, Die Arachniden, ix. p. 59, fig. 728.

♂.—*Colour*. Carapace covered with a coating of silky golden-red hairs; the long setæ on the legs and abdomen foxy red; ground-colour of legs olive-black, with two pale bands on the femur, patella, and tibia, and a short median basal band on protarsus; tarsus of palp and of legs darker than the rest of the appendage; coxæ, sternum, and lower side of abdomen velvety black.

Carapace longer than broad, its cephalic region compressed, moderately high; its length less than patella and tibia of fourth leg and less than those of second, a little greater than protarsus of fourth; its width equal to length of protarsus of fourth and to patella, tibia, and tarsus of palp.

Legs 4, 1, 2, 3 in length; tibiæ and protarsi of all the legs spined, those of the posterior more strongly than those of the anterior; tibial spurs of first leg like those of *Homœomma Stradlingi*, Cambr., but with the outer spur shorter and much less strongly curved; protarsus of this leg only slightly arched at the base. Bulb of palpus narrowly piriform, passing without constriction into the apical spine, which distally is lightly curved and sinuous, and is strengthened externally by a strong spiral crest or keel.

♀.—Resembling the male, but with much shorter legs; carapace as long as patella and tibia of first, longer than those of fourth; legs 4, 1, 2, 3 in length.

Measurements in millimetres.—♂. Total length 40; length of carapace 20, width 18; length of first leg 63, of second 59, of third 56, of fourth 68; patella and tibia of first 23, of fourth 22.

♀. Total length 42; length of carapace 20.5, width 18.5; length of first leg 54, of second 49, of third 46, of fourth 56.

Loc. Chili, Valparaiso.

The type and other specimens of this species, together with examples of the equally large Theraphosid *Paraphysa manicata*, Sim., were presented to the Museum by Col. Hayes Sadler, late H.B.M. Consul at Valparaiso. Colonel Sadler kindly furnished me with the following account of their habits:—"With the exception of one specimen [of *Paraphysa manicata*], which was obtained 20 miles S. of Santiago, these spiders were collected in the grounds at the back of the Hotel Vina del Mar, 6 miles from Valparaiso, in January and February. They live in holes in the ground, which consists of decomposed granite, or in crevices in the rock itself, the site chosen being a steep dry slope."

Paraphysa manicata has not ere this been recorded with

certainly from a definite locality *, Simon's example being quoted merely as South American.

It appears to me highly probable that this spider—*Oitha-roscelus Kochii*—is specifically identical with that which Koch described and figured as *Mygale rosea*, Walck.; but *Mygale rosea* of Walckenaer is, according to Simon, quite another species, and has been made the type of the genus *Phryxotrichus*.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

February 1st, 1899.—W. Whitaker, B.A., F.R.S.,
President, in the Chair.

The following communication was read:—

'On Radiolaria in Chert from Chypon's Farm, Mullion District (Cornwall).' By Dr. G. J. Hinde, F.R.S., F.G.S.

This paper describes the discovery of a bed of chert on the mainland, similar to that already described from Mullion Island. It was found in 1877 by Mr. Howard Fox at Chypon's Farm. Although detached blocks had been noticed in the fields, the rock had not been previously observed *in situ*. The chert is interbedded with clay-slates, and it is a dark massive rock much traversed by quartz-veins; in some parts of it the radiolaria are preserved in an unusually perfect condition, showing their latticed structure and spines very distinctly. The radiolaria for the most part are casts only, without any definite bounding-walls, their outlines being indicated by the dark material of the groundmass, while the interior of the test has been infilled with clear silica, sometimes the cryptocrystalline variety, at others fibrous chalcedony. In the forms showing the structural details, these alone have been replaced by the opaque substance, and are thus clearly defined against the clear silica infilling the test. Eleven species are described, of which ten are new, while one has been previously recognized in the cherts of New South Wales.

MISCELLANEOUS.

S.E. Union of Scientific Societies.

WE are informed by the Hon. General Secretary that the date of the next Congress of the above, which will be held at Rochester, has had to be altered to May 25th, 26th, and 27th, to suit the convenience of the local Society.

* In the 'Biol. Centr.-Americana,' Arachnida Araneida, vol. ii. p. 23, Mr. F. Cambridge erroneously states that these specimens were from Peru.

Revision of *Amphipoda*.

By the Rev. THOMAS R. R. STEBBING, M.A., F.R.S.

In the Ann. & Mag. Nat. Hist. for March 1899, at p. 241, a new genus was defined for the reception of *Corophium excavatum*, Thomson, but, by inadvertence, the name of the genus was omitted. It is *Paracorophium*. On p. 239, l. 15, for *Darwinii* (Bate) should be read *variegatus*, Leach.

This opportunity may be taken for announcing some other changes which I consider necessary in the nomenclature of the Amphipoda. *Microdeutopus chelifer*, Haswell, I propose to call *Microdeutopus Haswelli*, and to transfer his *Microdeutopus australis* to the genus *Limboidea*: the *Autonoe longidigitans* of Bonnier to the genus *Limbo*: *Maroides Thompsoni*, Walker, *Mara crassipes*, Haswell, *Mara dentifera*, Haswell, *Mara Chiltoni*, G. M. Thomson, *Paranania longimanus*, Chilton, and *Podocerospis palmata*, Stebbing and Robertson, all to the genus *Gammaropsis*. *Leptocheirus pilosus*, Della Valle, seems to be distinct from the species so-named by Zaddach, and may be distinguished as *Leptocheirus Dellavallei*. *Biancolina algicola*, Della Valle, appears to be identical with *Amphithoe cuniculus*, and will become *Biancolina cuniculus*. *Mara Haswelli*, G. M. Thomson, should, I think, be placed in Haswell's genus *Wyvillea*, a genus about which, however, more precise information is desirable. *Podocerus dentex*, Czerniavski, may, as *Jassa dentex*, include in its synonymy *Podocerus Herdmanni*, Walker, and *Podocerus odontonyx*, Sars. The *Siphonocetes typicus* described by Della Valle does not suit well with Kröyer's species, and deserves the independent title of *Siphonocetes Dellavallei*.

Dates of Charles d'Orbigny's 'Dictionnaire Universel d'Histoire Naturelle,' 1839-1849. By C. DAVIES SHERBORN and T. S. PALMER.

Careful collation of five copies of this 'Dictionnaire' shows that with the exception of volume i. there was only one composition—that is to say, if we take p. 100, for instance, the last word in every copy of every volume is identical. There was a re-composition of volume i., for one of us has examined an original copy in the U.S. Nat. Museum which differs in that the "Discours" is paged in roman (i-cxxl) and p. 100 terminates with "qui est," two words towards the end of the article "Acrodon." The other four copies of vol. i. which have been examined by us are themselves alike, but differ in that they have a new printer, some changes in authors, and a slightly different title-page. It is quite possible that there were reprints of some of the other volumes as they were exhausted, but there is nothing to show, so far as our researches go, that any re-setting of the type took place in any volume but volume i.

Of the five sets examined, that of the U.S. Nat. Museum is the most valuable, as, with the exception of vol. ii., it is apparently an original issue. It belonged to Professor S. F. Baird. The Zoological Society's copy shows what are probable reissues of the first five volumes.

ol.	B.M. (N. H.) General Library.		B.M. (N. H.) Tweeddale copy.		Zool. Soc.		U.S. Dept. Agriculture.		U.S. Nat. Mus.		Actual date of completed volume, with the authority.
	T. P. Date.	p. 100 ends with	T. P. Date.	p. 100 ends with	T. P. Date.	p. 100 ends with	T. P. Date.	p. 100 ends with	T. P. Date.	p. 100 ends with	
I.	1861	sous *	1861	"†	1847	"	1849	"	1811	qui est ‡	1841 [Jan.] Bull. Soc. géol. Fr.
II.	1849	-oïdes	1861	"	1844	"	1849	"	1843	"	1842 [Jan.] "
III.	1849	lemmus	1861	"	1843	"	1849	"	1843	"	1843 [Jan.] "
IV.	1849	semblables	1861	"	1846	"	1849	"	1844	"	1814 [Jan.] "
V.	1849	(E. D.)	1861	"	1848	"	1849	"	1844 §	"	1815 [Jan.] "
VI.	1849	les	1861	"	1846	"	1861	"	1845	"	1845 [Dec.] "
VII.	1849	Coquilles	1861	"	1846	"	1849	"	1846	"	1846. T. P. of sets 3 & 5.
VIII.	1849	tron	1861	"	1846	"	1849	"	1846	"	" & p. 704 ||.
IX.	1849	p. 196)	1861	"	1847	"	1849	"	1847	"	" & p. 337.
X.	1849	Spéciaux	1861	"	1847	"	1849	"	1847	"	" & p. 543.
XI.	1849	brusque re-	1861	"	1848	"	1849	"	1848	"	" & p. 202; & Bull. Soc. géol. Fr. [2] v. 1848, p. 613.
XII.	1849	multi-	1861	"	1848	"	1849	"	1848	"	1848. T. P. of sets 3 & 5; & Bull. Soc. géol. Fr. [2] v. 1848, p. 613 (1849 is an error for 1848).
III.	1849	autres	1861	"	1849	"	1849	"	1849	"	1849. T. P. of sets 3 & 5 & p. 196.

* The text of volume i., not the Introduction.

† , indicates that the vol. corresponds exactly with set 1.

‡ An original issue of vol. i.; see remarks in text.

§ This Sherborn suggests to be a printer's error for 1845; see livraison 60 in next list.

|| Joly's paper was published in Ann. Soc. Agric. Lyon, ix. 1846 (Hagen, Bibl. Entom.).

We learn from Bull. Soc. géol. France, vols. xi.-xiv., and series 2, vols. i. &c., that 71 parts were issued between February 1840 and November 1845, that 12 parts went to a volume, and other detailed particulars. These dates must be used cautiously, as they represent the dates of presentation to the Society, and, though in most cases it is unlikely, they may be several months after publication.

We give on p. 351 the collation of the several copies we have examined and the actual dates of issue of the completed volumes.

The following are the dates of presentation of the livraisons to the Geological Society of France, which can be verified by a reference to the 'Bulletin' of the Society:—

1. 17 Feb. 1840.	19. 7 Feb. 1842.	37. {	55. 18 Nov. 1844.
2. No record.	20. 21 Mar.	38. } 6 Nov. 1843.	56. 16 Dec.
3. No record.	21. 4 Apr.	39. }	57. { 6 Jan. 1845.
4. 16 Mar.	22. 16 May.	40. }	58. }
5. 6 Apr.	23. 20 June.	41. 4 Dec.	59. 17 Feb.
6. 15 June.	24. }	42. 8 Jan. 1844.	60. 7 Apr.
7. {	25. }	43. No record.	61. 5 May.
8. { 2 Nov.	26. } 7 Nov.	44. 19 Feb.	62. 19 May.
9. {	27. }	45. 4 Mar.	63. }
10. No record.	28. }	46. 15 Apr.	64. }
11. 21 Dec.	29. 5 Dec.	47. 6 May.	65. }
12. 8 Nov. 1841.*	30. 2 Jan. 1843.	48. 20 May.	66. }
13. 1 Feb.	31. 6 Feb.	49. }	67. } 3 Nov.
14. 5 Apr.	32. 6 Mar.	50. }	68. }
15. {	33. 17 Apr.	51. }	69. }
16. { 8 Nov.	34. 1 May.	52. } 4 Nov.	70. }
17. 6 Dec.	35. 5 June.	53. }	71. 17 Nov.
18. 24 Jan. 1842.	36. }	54. }	

From which it will be seen that the parts came out monthly, and there is no doubt that the 1st livraison appeared in December 1839 and the 71st livraison in October 1845. This accords both with the accounts of previous bibliographers, who usually ascribe the work to 1839-1849, and with the receipt of the livraisons by the French Geological Society. Thus, according to the data, each volume should have been completed in parts by the December of the year, and issued as a whole in the January following. Up to livraison 72, the end of vol. vi., this was undoubtedly the case, but there our record ceases, and there is plenty of evidence to show that the remaining 75 livraisons (there were 150 in all) came out in less than four years. We therefore urge the advisability of adhering to the dates of the *completed volumes* rather than to any speculative date of livraisons. Sets dated 1861 are merely re-issues with new titlepages.

* No doubt omitted in due course by publisher, and supplied later by request.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 17. MAY 1899.

L.—*On the Cretaceous Fish Plethodus.* By A. SMITH WOODWARD, F.L.S., of the British Museum (Natural History).

[Plates XIII. & XIV.]

IN his well-known work on the 'Geology and Fossils of Sussex' (1850) Frederic Dixon briefly described and figured some remarkable crushing-teeth or dental plates from the Sussex Chalk, to which he gave the name of *Plethodus*. He compared them with *Ptychodus*, and referred them to the Cestraciant sharks. Numerous specimens were subsequently discovered both in the Chalk and Cambridge Greensand, a few also in the Gault of Folkestone; and when I was occupied with a general survey of the English Cretaceous fish-fauna in 1887 I prepared several sections to demonstrate their microscopical structure. It was proved that beneath the thick dense layer of vertical tubules of dentine observed by Dixon there was an equally thick base of true bone with numerous typical bone-lacunæ. The problematical fossils could not therefore be retained any longer among the Elasmobranchii. They were referred to some undetermined bony fish; and one small specimen in the Willett Collection in the Brighton Museum was mentioned as displaying the *Plethodus*-plate "so placed in the midst of a skull as to suggest its connexion with the pharyngeal bones"*. During the last

* A. S. Woodward, "A Synopsis of the Vertebrate Fossils of the English Chalk," Proc. Geol. Assoc. vol. x. (1888) p. 331.

twelve years I have searched in vain among English Cretaceous fish-remains for further evidence on the subject. The time seems therefore to have arrived for describing the scanty fragments of *Plethodus*, so far as they are known, in the hope that this or allied genera may soon be more satisfactorily elucidated by some of the collections of Cretaceous fish-remains which are now being made in other parts of the world.

The type specimen of *Plethodus expansus**, now in the Willett Collection, Brighton Museum, is part of the side of a large dental plate probably resembling the original of Pl. XIII. fig. 1 in size and shape. The slightly sinuous but generally convex grinding-surface does not exhibit any punctations, and consists of a thin, yellowish, opaque layer covering the thick agglomeration of parallel vertical tubes of dentine, which form the main mass of the plate. There is a base, presumably of bone, beneath this mass, but it seems to be comparatively thin. The lateral border of the plate is somewhat truncated, and it may have borne a few blunt tubercles, but this is not quite certain.

The specimen thus briefly described was obtained from the Middle Chalk of Malling, Sussex; but the dental plate most closely resembling it in the British Museum (Pl. XIII. fig. 1) is one of a considerable series of more or less abraded examples from the Cambridge Greensand. It is much battered and also scratched by small boring organisms; but it is evidently almost complete. It measures about 0.10 m. in length by 0.075 m. in maximum breadth, and is bilaterally symmetrical. The broader end is gently rounded, and three quarters of the length of the plate in this direction rise to a gentle median convexity. The other end tapers to a point, and its oral face is concave. The grinding-surface of the tooth is not punctate; its truncated lateral border is covered with rather large obtuse tubercles, which are not coated with ganoine or gano-dentine (fig. 1*a*). The bony base of the dental plate is almost completely obscured by matrix, but where its lower face is exposed it exhibits very fine reticular markings, the main lines being longitudinal, the numerous less conspicuous cross-lines being at right angles to these. This reticulation is still more distinct on a fragmentary specimen from the Cambridge Greensand (Brit. Mus. no. 35392).

* The type species, Dixon, *op. cit.* p. 366, pl. xxxiii. fig. 2. For the loan of this and other specimens in the Brighton Museum I am indebted to the kindness of Henry Willett, Esq., F.G.S., and Edward Crane, Esq., F.G.S.

The more abraded and imperfect specimens of the same dental plate from the Cambridge Greensand (*e. g.* Brit. Mus. no. P. 7274) exhibit a distinctly punctate crown, the punctations usually bordered by a raised rim. These evidently depend upon the structure of the thin, opaque, superficial layer of the tooth, but are only evident when the outermost surface is destroyed.

The thick translucent layer of vertical dentine-tubules is always distinct in broken sections of the plates; and when the bony base is also preserved, this is seen to have a vertically fibrous structure curiously resembling that of the dentine, but much finer. Sometimes, indeed (*e. g.* Brit. Mus. no. 39103), appearances have been mistaken to indicate two dental plates, one resting on the other. The fibrous bony base is, in fact, nearly as thick as the crown, and there is a sharp plane of demarcation between these two parts, which are sometimes not completely in contact, but exhibit a small interposed cavity.

At the same horizons as these slightly convex leaf-shaped dental plates there occur somewhat concave plates of similar structure, which seem to represent the opposing dentition. They are, indeed, commonly labelled *Plethodus expansus* in collections. An imperfect specimen from the Lower Chalk of Glynde in the Brighton Museum (Willett Coll. no. 152) is broken across, exposing the characteristic dentine and basal bone, while its abraded oral face is punctate. It appears as if it had been bilaterally symmetrical, and from the middle of one end of the base there projects part of a fibrous azygous bony bar for an attachment of some kind. The bar is not seen at the other end, where, however, there is some indication of a paired connexion with adjoining bones. A more fragmentary specimen of the same plate with incomplete border is shown of two thirds the natural size in Pl. XIII. figs. 2, 2 *a*, 2 *b*. This was obtained from the Lower Chalk of Kent, and is now in the British Museum. It is remarkably concave, and must have been originally about as broad as long. Its oral face (fig. 2) is not punctate, but the marginal area is covered irregularly with numerous shallow pits. The truncated border (fig. 2 *b*) is tuberculated, as in the leaf-shaped plates, and the median bony bar (*p*) at one end, noted in the previous specimen, is especially well preserved, though still incomplete. The form and direction of this bar are shown in figs. 2, 2 *b*, while adjoining it on each side in a nearly parallel plane there are remains of a comparatively thin lamina of bone (*x*) of uncertain form. The attached face of the dental plate, so far as exposed, has the curious

aspect shown in fig. 2 a. The reticular lines already described on the base of the leaf-shaped plates are here most prominent in a transverse direction, and pass into a remarkable cluster of vermiculating fibres on the median longitudinal ridge. This ridge does not extend to the ends of the plate; and at the end opposite to that where the bony process appears the ridge terminates at the apex of a bilaterally-symmetrical triangular area, on which the reticular markings exhibit chiefly a divergent fan-shaped arrangement. Another imperfect abraded specimen of the same plate (Brit. Mus. no. 39091), exposed from its aboral face, shows that the terminal bony bar is a tolerably thin lamina directly continuous with the bony base and apparently similar to the latter in texture (fig. 3).

There is much variation in the contour of the plates of both kinds commonly referred to *Plethodus expansus*, but it seems best at present not to separate them under distinctive names. Perhaps the most striking variation is observed in the convex plate from the Gault shown of two thirds the natural size in Pl. XIII. fig. 4. Both ends of this fossil are comparatively truncated and the sides are nearly parallel; but in general aspect it closely agrees with the typical form from the Cambridge Greensand represented in Pl. XIII. fig. 1.

Some small convex plates from the English Lower Chalk, however, seem to be quite distinct from *P. expansus*, and it is now proposed to describe them under the new specific name of *P. pentagon*. The type specimen (Pl. XIII. fig. 5) from the Lower Chalk of Burham, Kent, is imperfect at one angle, where the section displays the dentinal structure characteristic of the genus. The plate is longer than broad, pentagonal in outline, pointed at one end, truncated and slightly excavated at the other end. The abraded oral face, with punctate markings, is very gently convex and slightly curved upwards at the two sharp angles bounding the truncated end. Three pits or depressions occur on the oral face near this end. The steep lateral border is not tuberculated. A fragment of the pointed end, also from Burham (Pl. XIII. fig. 6), bears numerous pits or depressions on the attenuated point. Much-abraded specimens from the Lower Chalk of Dover (Brit. Mus. no. 35874) and Lewes (Brit. Mus. no. P. 2693) are only of interest as extending the known distribution of the species.

The Lower Chalk also yields a concave dental plate which might serve very well for the opposing dentition of *P. pentagon*, though, as only detached specimens have been

discovered, its determination must still remain uncertain. The best plate of this form in the British Museum is shown of the natural size in Pl. XIII. figs. 7, 7a. It is strongly arched transversely, less so longitudinally, and a broken section at one end shows the characteristic structure. The oral face is not abraded, and is thus not punctate; it is deeply pitted at the lateral borders, which curve downwards to the coarsely tuberculated margin.

It may be observed that a somewhat similar form of dental plate, to be regarded as representing an allied species, *P. furcatus*, is known from the Turonian of Bohemia †.

A fourth form of dental plate referable to *Plethodus* is of comparatively small size, only 0·021 m. in length and 0·013 m. in maximum width. It is a unique specimen from the Lower Chalk of Clayton, Sussex, now in the Brighton Museum (Willett Coll. no. 153), and is described by Dixon under the name of *P. oblongus* (*op. cit.* p. 366, pl. xxxii.* fig. 4). It is gently rounded at its wider end, almost truncated at the narrower end, and the whole of the oral face is gently convex.

This specimen is of great interest because it seems to be closely similar to the rounded end of a thick dental plate mingled with the remains of a small problematical skull from the same pit, also in the Brighton Museum (Willett Coll. no. 154). In fact there can be little doubt that the latter fossil is referable to *Plethodus*, whether its determination as *P. oblongus* be right or wrong. There is thus at last some clue to the nature of the fish to which the dental plates under consideration belong. It is only strange that the first evidence as to the characters of the skull should appear in connexion with the smallest species, and not in association with the larger plates, which must have been connected with a very massive bony skeleton.

The imperfect skull in question is shown of the natural size from both sides in Pl. XIV. figs. 1, 1a. The cranium is much laterally compressed and about as deep as long, with a very steep frontal profile. At first sight, indeed, it exhibits much resemblance to that of the extinct Pycnodont fishes. The cranial roof-bones have a peculiar fibrous and punctate structure, and some of the sutures between them are distinguishable on the right (fig. 1). At the postero-lateral angle above the hyomandibular (*hm.*) the squamosal element is distinct (*sq.*), but its upper limit posteriorly is not quite clear. Adjoining the anterior half of its upper border there is a

† *Chimæra furcata*, A. Fritsch, 'Reptilien und Fische der böhmischen Kreideformation' (1878), p. 16, woodcut. Referred to *Plethodus* by A. S. Woodward, Proc. Geol. Assoc. vol. x. (1888) p. 331.

transversely elongated narrow bone, tapering as it reaches the broken median crest of the cranium; and this may probably be interpreted as a parietal (*pa.*) meeting its fellow in the median line. There may perhaps be a small supra-occipital crest (*x*), but this is uncertain. In front of the squamosal and supposed parietal only one bone can be distinguished forming the rostral region, and this probably consists of the pair of frontals fused with the mesethmoid. Postero-laterally, where in contact with the hinder elements, the bone exhibits radiating fibres like an ordinary frontal membrane-bone (*fr.*), but further forwards it becomes finely punctate and rugose. Two facettes on the border above the position of the orbit are probably for the overlap of the two membrane-bones noted in the next specimen. The upper part of the frontal profile is compressed to a sharp edge, but further down it displays a slight flattened concavity, while the extremity of the snout is broken away. A small depression on the surface of the undoubted frontal bone seems to represent a mucus-pit (*m.*). The basicranial axis, so far as preserved (to the border of the hyomandibular), is straight and parallel with the ridge of the cranial roof behind the frontal angle. Its constitution is uncertain, but as a median vertical lamina seems to extend from its upper face to meet the excessively developed mesethmoidal plate (*m.eth.*), the part preserved may possibly be a much-extended vomer (*v.*) like that of the Pycnodonts. It expands below the position of the eye and forms a thickened plate, which is distinctly concave on its oral face. The fossil is unfortunately cracked along the middle of this face, and the plate cannot be very satisfactorily studied; but it bears an extraordinary resemblance to the concave plates of *P. expansus* described above (p. 355, Pl. XIII. fig. 2), while its aboral face, especially on the left side (fig. 1 *a, u*), exhibits the peculiar fine reticulation already noted on the detached specimens. It must, however, be admitted that the peculiar denticinal structure so characteristic of *Plethodus* cannot be distinctly observed. Of the mandibular suspensorium, the very deep and narrow hyomandibular (*hm.*) is shown on each side, with a prominence on its thickened hinder border for the suspension of the operculum. The mandible (*d*) is rather fragmentary, but shown on the right side to be comparatively short and deep, implying a rather small gape. The right dentary bears minute, obtuse, styliform teeth on the border, apparently arranged in more than one series, while part of the inner face of the left dentary displays the surface of attachment for a dense cluster of minute teeth (*t*). Below the hinder end of

the mandible on the left side there is displayed one end of a comparatively thick convex dental plate (*h*), which has precisely the aspect of that of *Plethodus* both outwardly and in transverse section. It is not fixed upon bone, and may well have belonged to the hyoid arch. On the left side the preoperculum (*p.op.*) is shown to be very large and widely expanded at its angle. The operculum (*op.*) is only represented by a fragment.

A second example of this type of skull, in some respects more satisfactory, is preserved in the British Museum (no. 49895). This fossil, from the Lower Chalk of Dorking, Surrey, displays only the left side of the head, and is shown of the natural size in Pl. XIV. fig. 2. The same form of cranium is readily distinguishable; but the squamosal element is imperfect, the lateral margin of the frontal region is bounded by a postfrontal (*pt.fr.*) and a prefrontal (*pr.fr.*) membrane-bone, while the mesethmoid terminates in front in a thickened obtusely pointed rostrum (*r.*), which is ornamented with close reticulating ridges and lines of tubercles *. There are also two small plates posteriorly (*s.t.*) which may, perhaps, be supratemporals. The frontal (*fr.*) exhibits the mucus-pit (*m.*) as before, and it seems to cover only the hinder part of the rostral region, though its apparent boundaries in the fossil are probably deceptive and due to accidental cracks. The mesethmoidal septum (*m.eth.*) is seen to meet a vertical plate rising from the basicranial axis, and the latter exhibits the same remarkable expansion as in the previous specimen. At least this seems to be the case, for there is evidence of crushing in this region, and a longitudinal ridge along the supposed basicranial expansion is probably the fractured and slightly displaced base of the vertical plate just mentioned. In a plane distinctly external to the expansion there are remains of the hyomandibular (*hm.*) and the pterygo-quadrate arcade; the metapterygoid (*m.pt.*), quadrate (*qu.*), and long slender ectopterygoid with its minute teeth (*ecpt.*) being readily distinguishable. Indeed, if the previous specimens were unknown the expansion itself might readily be interpreted as entopterygoid, while the ridge upon it would be considered as an accidentally crushed and displaced slender parasphenoid. The maxilla (*mx.*) is a deep laminar bone, finely tuberculated at its oral margin, which forms the greater part of the upper border of the mouth. The premaxillæ are

* It may be noted that this rostrum exhibits much resemblance to a comparatively large tip of a snout from the Sussex Chalk, once provisionally assigned to an *Acipenseroid* fish (A. S. Woodward, Proc. Geol. Assoc. vol. xi. 1889, p. 31, pl. i. fig. 6).

unknown, but may be fused with the short ornamented rostrum, which curves inwards to the mouth below and seems to bear minute teeth. The mandible, as before, is shown to be short and deep, the dentary (*d.*) forming by far the greater part of the ramus. A fragment within the jaws may possibly be part of the lower dental plate, but it is unusually pitted and of doubtful nature. The operculum (*op.*) and the curved anterior border of the preoperculum (*p.op.*) are also seen.

The evidence afforded by the two skulls now described is thus very suggestive, but not quite conclusive as to the relationships of the dental plates named *Plethodus*. It is still necessary to demonstrate by microscopical sections that the plates in this small form of skull are truly *Plethodus*. It is also essential to obtain a clearer view of the basicranial axis before definitely deciding upon the homologies of the upper plate. Meantime, however, it seems almost certain that the concave plate of *Plethodus* was part of the upper dentition fixed to the basicranial axis, while the convex plate belonged to the lower dentition and was supported by the hyoid apparatus. The upper plate may have been part of the parasphenoid—an arrangement common among fishes—or it may have belonged to a much-extended vomer like that of the extinct Pycnodonts.

There is only one difficulty in regarding the concave plate of *P. expansus* as homologous with the upper plate in the small form of skull now described, namely that the aboral face is a little different. The median ridge in the known specimens of *P. expansus* does not definitely rise into a vertical plate, though this may have been comparatively fragile and readily broken away; moreover, in the larger plate the strongest lines in the fine reticulation on either side of the median ridge are directed transversely, while those in the original of Pl. XIV. fig. 2 are longitudinal. It is, however, possible that accident in the first case and specific difference in the other may account for the discrepancy. If the homology prove to be well founded, it is likely that the end of the plate connected with the ascending bar of bone (Pl. XIV. fig. 2, *p*) is posterior.

Finally, assuming that the new type of skull now described does really represent the genus *Plethodus*, it is still difficult to hazard a suggestion as to the precise affinities of the fish. The structure of the mandible shows that it is not a Pycnodont, while the apparent discovery of a hyoid or lingual dentition opposed to the upper dentition of the mouth adds a feature not previously known among Mesozoic fishes. The dental arrangement, indeed, is most closely similar to that of

some of the existing Osteoglossidæ, a family which was already differentiated in the Eocene in North America (*Dapedoglossus*) and probably also in Europe (*Brychætus*). If the patches of minute teeth on the parasphenoid and basi-hyal of the recent *Arapaima* were fused together into opposing plates their structure would not be very different from that of *Plethodus*. The disposition of the squamosal and parietal bones in the Cretaceous fish limits comparisons to primitive bony fishes such as the Osteoglossidæ, Elopidae, and Albulidæ. On the whole, I am inclined to think that *Plethodus* will eventually prove to be most closely related to the first of these families.

EXPLANATION OF THE PLATES.

PLATE XIII.

- Fig. 1.* *Plethodus expansus*, Dixon; lower dental plate, oral face, two thirds nat. size, and view of tuberculated rim (1 *a*), nat. size.—Cambridge Greensand. [B.M. no. 35369.]
- Fig. 2.* Ditto; upper dental plate, oral face, aboral face (2 *a*), and side view of supposed posterior end (2 *b*), two thirds nat. size.—L. Chalk; Kent. *p*, median bony process; *r*, lateral bony plate. [B.M. no. 38585.]
- Fig. 3.* Ditto; upper dental plate, aboral face, two thirds nat. size.—Ibid. [B.M. no. 39091.]
- Fig. 4.* Ditto (?); lower dental plate, oral face, two thirds nat. size.—Gault; Folkestone. [B.M. no. P. 7.]
- Fig. 5.* *Plethodus pentagon*, sp. n.; lower dental plate, oral face.—L. Chalk; Burham. [B.M. no. 41716 *a*.]
- Fig. 6.* Ditto; pointed end of plate, oral face.—Ibid. [B.M. no. 47947.]
- Fig. 7.* Ditto (?); upper dental plate, oral face, and lateral aspect (7 *a*).—English Chalk. [B.M. no. P. 5626.]

PLATE XIV.

- Fig. 1.* *Plethodus oblongus*, Dixon (?); imperfect head, right and left (1 *a*) lateral aspects.—L. Chalk; Clayton. [Willett Coll., Brighton Museum, no. 154.]
- Fig. 2.* Ditto; imperfect head, left lateral aspect.—L. Chalk; Dorking. [B.M. no. 49895.]

d., dentary of mandible; *ectp.*, ectopterygoid; *fr.*, frontal; *h*, lower dental plate (? basihyal); *hm.*, hyomandibular; *m.*, mucus-pit; *m.eth.*, mesethmoid; *m.pt.*, metapterygoid; *m.x.*, maxilla; *op.*, operculum; *p.op.*, preoperculum; *pa.*, parietal; *pr.fr.*, prefrontal plate; *pt.fr.*, postfrontal plate; *qu.*, quadrate; *r*, rostrum; *s.t.*, supratemporals (?); *sq.*, squamosal; *i*, inner mandibular teeth; *u*, upper dental plate; *x*, supraoccipital (?).

B.M.=British Museum. Unless otherwise stated, the figures are of the natural size.

LI.—On a Collection of Odonata (Dragonflies) from Panama. By W. F. KIRBY.

[Plate XV.]

IN the course of last year I received a consignment of *Odonata* for the Natural-History Museum from Mr. Charles H. Dolby-Tyler. They were all taken by himself between April 1 and May 15, 1898, at La Chorrera, about 20 miles north of Panama. Accompanying them were short descriptions, "taken in most cases from two or three specimens while the insect was alive, and jotted down in my note-book. . . . Among the unnumbered duplicates you will find two, or possibly three, species not included in the series."

The numbers on the specimens run from 1 to 20; but as the sexes of several species bore different numbers, the total number of species (including those not numbered) is not more than 21. Several of these are of considerable interest and some appear to be new; and hence I have thought it would be useful to give a list of the whole, printing Mr. Dolby-Tyler's descriptions of the living insects exactly as I received them, between inverted commas, and adding any remarks of my own which seemed to be necessary. As usual, many more males than females were collected.

The list of species is as follows:—

Libellulidæ.

LIBELLULINÆ.

Miathyria, Kirb.
marcella, *De Selys*.
Perithemis, Hagen.
domitia, *Dru*.
Trithemis, Brauer.
pulla, *Burn*.
Tyleri, *Kirb.* (sp. n.).
Orthemis, Hagen.
ferruginea, *Fabr*.
Dythemis, Hagen.
Broadwayi, *Kirb*.
Macrothemis, Hagen.
vulgipes, *Culv.* (?)
Uracis, Ramb.
quadra, *Ramb.* (?).
Leptthemis, Hagen.
vesiculosa, *Fabr*.
Mesothemis, Hagen.
verbenata, *Hagen*.
Erythemis, Hagen.
peruviana, *Ramb*.
Micruthyria, Kirb.
Hagenii, *Kirb*.
Diplacodes, Kirb.
minuscule, *Hag*.

Æschnidæ.

GOMPHINÆ.

Gomphoides, *De Selys*.
appendiculatus, *Kirb.* (sp. n.).
Cyclophylla, *De Selys*.
obscura, *Kirb.* (sp. n.).

Agrionidæ.

AGRIONINÆ.

Heterina, *De Selys*.
occisa, *De Selys*.
cava, *Drury* (?).

CENAGRIONINÆ.

PSEUDOSTIGMATINÆ.

Mecistogaster, *Ramb*.
ornatus, *Ramb*.

NORMOSTIGMATINÆ.

Aryia, *Ramb*.
tinctipennis, *De Selys*.
orichalcea, *De Selys*.
pulla, *De Selys*.

Liathyria marcella.

Libellula marcella, De Selys, Ramon de la Sagra, Hist. Cuba, Ins. p. 452 (1857).

(♂, no. 1.) "Apex of eye red, with a purple tint, the remainder infuscated purple. Epicranium metallic purple. Ante- and postclypeus olivaceous. Labrum fuscous. Dorsal aspect of mesepisterna and notum bluish black.

"Tergum of abdomen ochreous. Tergites 1-3 fuscous, 4-9 ochreous, edged with black. Median line black, growing gradually broader from base up to the ninth tergite, where the ochreous ground appears only as two lateral spots. Tenth tergite and cercopoda black; tergites 4-8 with two fuscous marks towards the apex of each tergite, these markings on the ninth becoming merged into the median line."

Three male specimens.

Perithemis domitia.

Libellula domitia, Dru. Ill. Ex. Ent. ii. pl. xlv. fig. 4 (1773).

(♂, no. 3.) "Apex of eye fuscous; middle third with a faint purplish tint horizontally; lower third from the epicranial suture downwards, together with the clypeus and labrum, olive-green. Epicranium yellowish green.

"Dorsal aspect of mesepisterna and notum dark green, faintly æneous.

"Abdominal tergites olive-green, marked diagonally towards the outer edges with fuscous fasciæ, bordered laterally with light brown. Edges of tergites ochreous. Cercopoda olive-green."

Six male specimens.

Trithemis pulla.

Libellula pulla, Burm. Handb. Ent. ii. p. 855. n. 41 (1839).

(♂ adult, no. 17.) "Apex of eye rufescent, balance cinereous. Epicranium, clypeus, and labrum rufescent. Dorsal aspect of mesepisterna bronzy green. Notum dark green.

"Tergum of abdomen rufescent. Tergites 1-3 greenish, 4-8 with diagonal luteous markings from outer angle at base of each tergite inclining towards the median line, 9-10 testaceous. Cercopoda red."

(♂ semiadult, no. 4.) "Eyes piceous, with dark crimson apices. Epicranium, clypeus, and labrum crimson.

"Dorsal aspect of mesepisterna, notum, and abdominal tergites dark crimson. Median line of tergum black. Edges

of tergites black. Cercopoda dark crimson, tipped with black."

(♀, no. 10.) "Apex of eye reddish brown, balance greyish green. Epicranium, clypeus, and labrum olivaceous. Dorsal aspect of mesepisterna and notum olive-green.

"Tergal aspect of abdomen rufo-flavescent, marked longitudinally towards the outer edges of each tergite and near its base with yellow. Median line and edges of tergites black. Cercopoda tipped with black."

Twelve specimens in all.

Trithemis Tyleri, sp. n. (Pl. XV. fig. 1.)

(♂, no. 13.) "Apex of eye piceous, balance bluish grey. Postclypeus olivaceous. Epicranium, anteclypeus, and labrum dark olivaceous generally.

"Dorsal aspect of mesepisterna, notum, and abdominal tergites 1-3 dark infumated green, 4-10 fuscous, bordered with black. Cercopoda olivaceous."

Closely allied to *T. umbrata*, Linn.; but in that species the purplish-brown band lies between the nodus and the stigma, whereas in *T. Tyleri* it extends from about the triangle of the fore wings to halfway between the nodus and the pterostigma, and the lower basal cell is slightly clouded as far as the base. The hind wings are clouded from the base to the outer level of the band of the fore wings, but the basal part of the hind wings is paler than the rest of the clouded portion, especially in the female.

Described from three males and two females.

Orthemis ferruginea.

Libellula ferruginea, Fabr. Syst. Ent. p. 428. n. 19 (1775).

(♂, no. 14.) "Apex of eye purplish, balance dark bluish. Epicranium crimson, with a tinge of purple. Clypeus and labrum rufescent.

"Dorsal aspect of mesepisterna and notum infumated purple.

"Tergum of abdomen bright crimson."

(♀, no. 16.) "Apex of eye rufescent, balance grey.

"Front olivaceous.

"Dorsal aspect of mesepisterna fuscous, with a pale green median line. Notum fuscous, with a pale green median line, which extends to the fourth abdominal tergite, where it becomes somewhat flavescent and constricted; it then narrows down to the seventh, where it is scarcely perceptible. Tergites 8-10 and cercopoda somewhat rufescent."

Two males and two females sent.

Dythemis Broadwayi.

Dythemis Broadwayi, Kirb. Ann. & Mag. Nat. Hist. (6) xiv. p. 227 (1894).

Dythemis sterilis, Calv. (or Hagen?), Proc. California Acad. (2) iv. p. 522, pl. xvi. figs. 52-55 (1895).

Dythemis velox (Hagen), var. *sterilis*, Calv. Proc. Boston Soc. Nat. Hist. xxviii. p. 310 (1898).

(♂, no. 7.) "Apex of eye red, balance greyish green. Epicranium fulvous; clypeus and labrum olivaceous.

"Dorsal aspect of mesepisterna green, with two darker-hued metallic fasciæ on either side of, separated from, and parallel to the median line. Notum green, with black border.

"Abdomen black, with green markings. In tergite 2 the markings occupy nearly all the surface, in 3-7 they are acutely triangular and basal, running parallel to and on either side of the median line; they become nearly obliterated on the eighth tergite. Cercopoda black."

Two specimens.

I provisionally retain my name *D. Broadwayi* for this species or variety, for Hagen's name of *D. sterilis* was intended to replace *tessellata*, Ramb. (nec Burm.), from Buenos Aires; and in the absence of specimens from that locality agreeing with Rambur's *tessellata*, and to which Hagen's name of *sterilis* is alone primarily applicable, I do not care to apply it to specimens from widely different localities without further evidence.

Macrothemis vulgipes (?).

Macrothemis vulgipes, Calvert, Proc. Bost. Soc. Nat. Hist. xxviii. p. 320 (1898).

(♀, no. 8.) "Apex of eye reddish brown, bordered with glaucous, lower portion olive-green. Epicranium fuscous near suture at base of ocelli-bearing sclerite; clypeus and labrum olivaceous.

"Dorsal aspect of mesepisterna fuscous, with two green fasciæ running parallel to, separate from, and on either side of the median line. Thorax fuscous, with green markings.

"Tergum of abdomen black. Tergites 1-5 with lateral longitudinal green markings, 7 with two green markings."

Two specimens, agreeing with Prof. Calvert's description, except that the wings are clear hyaline, with no yellow tinge except at the base, and that the double row of post-triangular cells on the fore wings only increases to three on the hind margin instead of to four; in one specimen, indeed, there is only one row of these cells on the margin itself. On the fore wings the arculus corresponds with the second antenodal

cross-nervure on the fore wings, and rises considerably beyond it on the hind wings.

It is quite possible that Mr. Dolby-Tyler's insect may be distinct from *M. vulgipes*, Calv., but I do not like to separate them until the allied forms are better known.

Two specimens.

Uracis quadra (?).

Libellula quadra, Ramb. Ins. Névr. p. 31, pl. ii. fig. 5e (1842).

(♀, no. 12.) "Apices of eyes green, balance cinereous, together with the epicranium, clypeus, and labrum, the last-mentioned somewhat olivaceous.

"Dorsal aspect of mesepisterna black, with rugose flavescent markings transversely. Notum grey. Tergum of abdomen deep fuscous, with somewhat flavous markings.

"Tips of wings fuliginous."

Nine specimens in the collection, belonging to both sexes. They agree fairly well with Rambur's figure and description of *U. quadra*, except that the triangle of the hind wings is followed by only two rows of cells increasing, not three, as in Rambur's figure. It may be noted that the true *U. quadra*, Ramb., is the type of his genus *Uracis*; not *imbuta*, Burm., which is a perfectly distinct species, with a pruinose blue male. The species which I here call *U. quadra* may be known by the upper surface of the thorax being finely and transversely striated with brown and black.

Leptthemis vesiculosa.

Libellula vesiculosa, Fabr. Syst. Ent. p. 421. n. 7 (1775).

(♂, no. 11.) "Eyes green, rufescent at apices, remainder greyish. Vertex, ocelli-bearing sclerite, epicranium, clypeus, and labrum verdant green.

"Dorsal aspect of mesepisterna, notum, and abdominal tergites 1-3 verdant green; tergites 4-7 green with black apices, 8-10 black. Cercopoda green.

"Pterostigma green."

One male specimen.

Mesothemis verbenata. (Pl. XV. fig. 2.)

Leptthemis verbenata, Hagen, Neur. N. Amer. p. 162 (1861).

(No. 5.) "Apex of eye rufescent, remaining portion grey with a greenish tinge. Epicranium, clypeus, and labrum olivaceous.

"Dorsal aspect of mesepisterna, notum, and abdominal tergites 1-3 dull green, 3 to last olivaceous, with fulvous

markings, which become flavescent towards the outer edges ; these last are black.

"Tergites 8-9 somewhat rufescent. Median line black."

There are seven males and one female in the collection, and although one of the males bears the no. 5, the above description was probably taken from the female, to which it seems to be much more applicable.

Lepthemis verbenata, Hagen, is usually considered to be a mere synonym of *Mesothemis attala*, Selys ; but, as far as I can tell without actually examining Hagen's types, the species sent by Mr. Dolby-Tyler is the true *verbenata* and has every appearance of a *Lepthemis*, especially as Hagen understood that genus in 1861. It has all the most important structural characters of *M. attala*, which it much resembles, but the abdomen is much longer and more slender, segments 4-7, though slightly decreasing in length, being about four times as long as broad, whereas they are less than twice as long as broad in *M. attala*. The cross-nervures are also less by one or two in *verbenata*, none of the specimens before me having more than 14, and often only 13, antenodal cross-nervures on the fore wings, while all our *M. attala* have 15. The female corresponds fairly with Hagen's description of *L. verbenata* ; the males are the dark form which he describes. The latter, however, are not quite so dark as Hagen's description might imply, for the base of the mandibles and the sides of the labrum are testaceous, and the femora are lined with red.

This is one of the most interesting species in the collection.

I have just heard from Prof. Calvert that he also regards the two species as distinct.

Erythemis peruviana.

Libellula peruviana, Ramb. Ins. Névr. p. 81 (1842).

(♂, no. 2.) "Eyes bluish black. Ocelli, epicranium, clypeus, and labrum black.

"Dorsal aspect of mesepisterna and notum dark blue, approaching black, this colour extending to the middle of the third abdominal tergite. Apical half of third tergite, tergites 4-10, and cercopoda bright crimson."

(♀, no. 15.) "Eyes greyish. Epicranium posteriorly dirty white, bordered anteriorly with black. Clypeus and labrum olivaceous.

"Dorsal aspect of mesepisterna pale green, bordered laterally with fuscous. Notum pale green.

"Tergum of abdomen pale green, bordered laterally with fulvous, and this exteriorly with ochreous."

Four males and two females in the collection.

Micrathyria Hagenii.

Dythemis didyma, Hagen (nec De Selys), Neur. N. Amer. p. 165 (1861).

Micrathyria Hagenii, Kirb. Cat. Neur. Odon. p. 41 (1890).

(♂, no. 6.) "Eyes bright green, clouded with blue. Ocelli black. Epicranium, clypeus, and labrum dirty white.

"Dorsal aspect of mesepisterna bright green, with black fasciæ. Notum bluish black.

"Tergites of abdomen black; tergites 2-5 with interrupted green markings extending from the base of each tergite over two thirds of its length, and forming apparently two markings on each side of the median line. The apical half of these markings becomes obliterated in the fifth, and in the sixth there are traces only of their basal portions; seventh with two oblong markings, concolorous with the others, occupying two thirds of the surface from the base."

Four males. The interalary portion of the thorax above is pruinose. They may represent a local form of *M. Hagenii*. On the fore wings there are only 8 antenodal cross-nervures (the last not continuous) and 6-8 postnodals. The hinder segments are considerably enlarged. In most points they agree very well with Hagen's description.

Diplacodes minuscula.

Libellula minuscula, Ramb. Ins. Névr. p. 115 (1842).

Diplac. minuscula, Hag. Neur. N. Amer. p. 183 (1861).

(Immature ♂, no. 9.) "Apex of eye rufescent, remaining portion green. Epicranium fuscous, with a dark metallic blue reflection. Clypeus olivaceous and labrum blackish towards front.

"Dorsal aspect of mesepisterna and notum fulvous. Abdominal tergites flavous, with black edges, and concolorous at base and apex and on either side of median line, forming two fenestra.

"Cercopoda flavescent."

A single specimen only.

Gomphoides appendiculatus, sp. n. (Pl. XV. fig. 3.)

(♂, no. 18.) "Description lost."

Long. corp. 50 millim.; exp. al. 71 millim.; long. pter. 4 millim.

Male.—Head and thorax reddish chocolate, head with the occiput (?) (discoloured), a square spot in front of it between the eyes; a transverse band before the frontal ocellus, the

sides of the face above the base of the mandibles, and the lower mouth-parts black; borders of labrum and mandibles black, two yellow dots on the labrum. Prothorax with a short oblong yellow spot in the middle. Mesothorax with a yellow collar, divided in the middle; a transverse expanding yellow median line, followed by a series of yellow spots between the wings as far as the base of the abdomen, and a short oblique yellow stripe on each side, followed by a yellow spot opposite the base of each fore wing. A very broad yellow stripe beneath each wing; metapectus with two oblique yellow stripes. Abdomen with the first six segments with oblong yellow markings at their base on the sides: the median line above is mostly yellow nearly to the extremity, bordered with blackish on the sides and sutures; on the seventh segment the yellow stripe is interrupted, being followed by a detached spot; the last three segments are expanded, dull yellow above, with the sides brown, and the terminal carinæ black. Lateral appendages of second segment yellow. Anal appendages as long as the last two segments, yellow, black at the base and tips, curved inward; a small black tooth on the upperside beyond the middle, and the tips upcurved. Lower appendages brown, one fourth as long as the others, diverging, slender, pointed; lowest appendage broader, longer, directed obliquely downwards, and truncated at the extremity. Legs black, femora yellowish below and serrated. Wings hyaline: fore wings with 20 antenodal cross-nervures and 11 or 12 postnodals; 2 supratrangular nervules on all the wings; pterostigma brownish ochreous, between black nervures; fore wings with the triangle of 2 or 3 cells, followed by two rows of cells, increasing, subtriangular space (lower triangle of De Selys) divided by a nervure: hind wings with 13 or 14 antenodal and postnodal cross-nervures, triangles traversed, followed by one row of 3 cells and then by several of 2, increasing; anal triangle of 4 cells; subtriangular space divided.

I suspect that this insect may be the male of *G. bifasciatus*, Hagen, described from Tehuantepec, but cannot put them together without authority.

One specimen only.

Cyclophylla obscura, sp. n. (Pl. XV. fig. 4.)

(♀, 0.) No description.

Long. corp. 55 millim.; exp. al. 76 millim.; long. pter. $4\frac{1}{2}$ millim.

Uniform dark reddish brown, inclusive of neuration; sides
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of mandibles and lower mouth-parts paler; tips of mandibles, tibiae, and tarsi black; seventh and eighth segments considerably widened, the seventh, which is twice as long as the eighth, gradually widened, nearly from the base; ninth and tenth segments successively narrower, about as long as broad; anal appendages as long as the tenth segment, conical, porrected, pointed at the tips.

Wings hyaline; pterostigma ochreous yellow, between black nervures, covering six or seven cells; one supratrangular nervure on each wing: fore wings with 20-21 antenodal and 13-14 postnodal cross-nervules; triangle formed of three cells, followed by one or two rows of three cells and then several of two, increasing; lower triangle traversed: hind wings with 13-17 antenodals and 15-17 postnodals; triangle traversed; lower triangle free.

One specimen.

Very few females of this genus have been described; but the present specimen does not seem to agree with any described male.

Heterina occisa.

Heterina occisa, De Selys, Syn. Cal. p. 44 (1853); Mon. Cal. p. 143 (1854).

One well-marked male, with no special number.

Heterina caja (?).

? *Libellula caja*, Drury, Ill. Ex. Ent. ii. pl. xlv. fig. 2 (1773).

Calopteryx caja, pt., Ramb. Ins. Névr. p. 226 (1842).

Heterina caja, De Selys, Syn. Cal. p. 32 (1853); Mon. Cal. p. 104 (1854).

Heterina hera, Hagen, De Selys, *ll. cc.* p. 32 (1853); p. 106 (1854).

(♂, no. 19.) "Eyes black, lower and outer portion grey. Epicranium with a red fascia horizontally (transversely?) in front of ocelli, and separated from the anterior portion, which is fulvous, by a black line. Postclypeus purplish black. Anteclypeus olivaceous. Labrum grey. Scape of antennæ grey.

"Dorsal aspect of mesepisterna crimson, divided by the black median line. Thorax and abdominal tergites 1-5 tuscous; fifth tergite much darker, and merging into the colour of tergites 6-10 and cercopoda, which is dark green."

A series of twenty-two specimens, males and females. If this insect ultimately proves not to be the true *H. caja*, Dru., Hagen's name of *H. hera* (omitted in my Catalogue) must be adopted for it.

Mecistogaster ornatus.

Mecistogaster ornatus, Ramb. Ins. Névr. p. 288 (1842).

One specimen only. No number attached.

Argia tinctipennis.

Argia tinctipennis, De Selys, Bull. Acad. Belg. (2) xx. p. 396 (1865).

Two males, without special number.

I find the name of this species is misprinted *tractipennis* in my Catalogue of Odonata.

Argia orichalcea.

Argia orichalcea, De Selys, Bull. Acad. Belg. (2) xx. p. 408 (1865).

Agrion cupreum, var., Hag. Neur. N. Am. pp. 97, 312 (1861).

(♂, no. 20.) "Front hemisphere of eye bright red; apical half posteriorly black, lower posterior half grey. Epicranium fuscous. Clypeus brown-æneous, same as dorsal aspect of mesepisterna; notum blue.

"Tergum of abdomen blue, with an annular black fascia at the apex of each tergite. Tergite 8 almost entirely black."

Two males; and a very dark-coloured female, possibly not belonging to the same species.

Argia pulla.

Argia pulla, De Selys, Bull. Acad. Belg. (2) xx. p. 410 (1865).

Four specimens, without special number.

EXPLANATION OF PLATE XV.

Fig. 1. *Trithemis Tyleri*, sp. n., p. 364.

Fig. 2. *Mesothemis verbenata*, Hagen, p. 366.

Fig. 3. *Gomphoides appendiculatus*, sp. n., p. 368. a, b, anal appendages.

Fig. 4. *Cyclophylla obscura*, sp. n., p. 369.

LII.—*Descriptions of Two new Moths collected by Dr. Christy on the Upper Niger.* By EMILY MARY SHARPE.

Family Saturniidae.

Bunea Christyi, sp. n.

Allied to *Bunea phædusa* (Drury), but at once distinguished by the very large ocellus on the fore-wing, which is similar to that on the hind-wing in markings and colour.

Primaries. General colour greyer than in *B. phædusa*, the outline of the hind margin more distinctly curved; the basal portion of the median nervure up to the first branch longer, the bend of this portion of the wing being further from the base; the narrow brown line which crosses the discal area from the apex curving more towards the posterior angle than in the allied species, the violaceous shading only visible on the outer margin of the brown discal line and only confined to the apical area.

Secondaries. Similar to those of *B. phædusa*, the ocellus being somewhat larger.

Underside. General aspect much greyer on both wings, the dark brown patches situated at the end of the discoidal cells deeper in colour and larger, and more distinctly outlined with black; the outer margin of the primaries more concave between the nervules; collar entirely white, whereas in the allied form it is of the same colour as the wings.

Expanse 7·7 inches.

Hab. Jebba, Upper Niger, October 1898 (*Dr. Cuthbert Christy*).

Nudaurelia jebbae, sp. n.

Nearest to *Nudaurelia Rendalli*, Rothschild (Novit. Zool. iv. p. 182), from Zomba in Nyasaland, but distinguished by the ground-colour being altogether of a more reddish tint.

Primaries. Shorter than in *N. Rendalli*, the outer margin more convex, as is also the greyish discal line, which is divided from the hind margin by a band of reddish brown, the same colour being visible over the whole of the basal area; a small transparent ocellus situated at the end of the discoidal cell.

Secondaries. The ground-colour similar to that of the primaries; the dark post-discal line, visible in *N. Rendalli*, absent in this species, and the ocellus in the centre of the wing twice the size of that in *N. Rendalli*.

Underside. General colour brighter and deeper red, the ocellus at the end of the discoidal cell on the primaries distinctly outlined with black, the greyish discal line only faintly indicated.

Secondaries. Similar to the primaries, the discocellular spot represented by a very narrow transparent streak, the dark markings from the upperside being only faintly indicated; the discal line is faintly visible.

Antennæ black, collar white; while in *N. Rendalli* the antennæ are tawny brown and the collar ochraceous.

Expanse 3·5 inches.

Hab. Jebba, Upper Niger, October 1898 (*Dr. Cuthbert Christy*).

I have compared the types of these species with others in the collections in the British Museum and at Tring, and both the Hon. Walter Rothschild and Sir George Hampson agree with me that the two species are new to science.

LIII.—*A Revision of the Dismorphina of the New World, with Descriptions of new Species.* By ARTHUR G. BUTLER, Ph.D., F.L.S., F.Z.S., &c.

WHEN I revised the genera of Pierine Butterflies in the 'Cistula Entomologica' (vol. i. pp. 33-58) I admitted two genera of Dismorphina, viz. *Dismorphia*, with the upper radial of the primaries emitted from the end of the discoidal cell, and *Moschoneura*, with the same vein emitted from the subcostal vein beyond the end of the cell. A careful study of the neururation of all the species in the Museum series failed to show any other difference in neururation which was absolutely constant.

Under *Moschoneura* I placed the *nehemiu* group, which has since been separated under the name *Pseudopieris* by the authors of the 'Biologia Centrali-Americana,' I think correctly, for although it has the neururation of *Moschoneura*, it differs considerably in form of wing and is evidently not a mimicking group.

The two other genera erected in the 'Biologia' have less claim to generic rank, inasmuch as they are based upon neurational differences which are far from being constant. *Acmepteron* is perhaps convenient as a division on account of the peculiar form of the primaries; but *Enantia* can only be arbitrarily separated as a group or section of *Dismorphia*, the position of the first subcostal branch of the primaries, upon which its authors relied, being unfortunately very variable, quite as much so as in the genus *Euchloe*; indeed, I find it emitted both before and at the end of the cell in examples of the same species, whilst in a closely allied species it is emitted well beyond the end. Even the Ithomeine character of *Dismorphia* does not form a trenchant distinction, because several admitted forms of *Enantia* have Ithomeine females.

The following is an account of the species, most of which are either in the general series or the Hewitson collection in the Museum.

Genus PSEUDOPIERIS, Godm. & Salv.

The species of this genus have the aspect of *Pieris* and are probably the most ancient of the New-World Dismorphina. They are all very closely related.

1. *Pseudopieris æquatorialis*.

Leptalis æquatorialis, Felder, Wien. ent. Monatschr. v. p. 75 (1861).

Leptalis penia, Hopffer, Stett. ent. Zeit. 1874, p. 334.

"Ecuador" (*Felder*) ; Pucartambo, Peru (*Whitely*). ♂, B. M.

♂, *P. penia*, hab.? Three examples. Ecuador. Coll. Hewitson.

Our specimen is the wet phase = *P. æquatorialis*, *P. penia* is intermediate, and the examples from Ecuador in the Hewitson series (mistaken for *P. nehemia* by Hewitson) represent the dry phase.

2. *Pseudopieris viridula*.

Leptalis viridula, Felder, Wien. ent. Monatschr. v. p. 75 (1861).

"Bogota" (*Felder*). Pucartambo and Rio Napo : B. M. Quito : coll. Hewitson.

The wet phase is unknown to me, but the intermediate we have from the Rio Napo and the dry from Pucartambo and (in the Hewitson series) from Quito.

3. *Pseudopieris nehemia*.

Pieris nehemia, Boisduval, Sp. Gén. Lép. i. p. 528 (1836).

Leptalis cydno, Doubleday, in Gray's Zool. Misc. p. 75 (1842).

Mexico, Venezuela, and Rio Grande : B. M. Minas Geraes and Rio Janeiro : coll. Hewitson.

I have not seen the wet phase, but Doubleday's type from Mexico represents the intermediate, and typical *P. nehemia* from all our more southern localities the dry.

Genus MOSCHONEURA, Butler.

The species of this genus are capital imitations of the species of the Ithomeine genera *Scada* and *Aeria*.

1. *Moschoneura methymna*.

Pieris methymna, Godart, Enc. Méth. ix. p. 166 (1819).

Rio Janeiro. B. M. and coll. Hewitson.

2. *Moschoneura cyra*.

Leptalis cyra, Doubleday, Ann. & Mag. Nat. Hist. vol. xiv. p. 418 (1844).

Bahia. Type, B. M.

3. *Moschoneura ela*.

Leptalis ela, Hewitson, Equat. Lep. p. 82 (1877).

Ecuador. Type, coll. Hewitson.

4. *Moschoneura pinthæus*.

Papilio pinthæus, Linnæus, Mus. Lud. Ulr. p. 258 (1764).

Papilio vocula, Cramer, Pap. Exot. iv. pl. cccliii. C, D (1782).

Leptalis amelina, Hopffer, Stett. ent. Zeit. 1874, p. 332.

Para and Tapajos. B. M. and coll. Hewitson.

I can discover no difference in Hopffer's description to warrant the separation of his species; but in the Hewitson collection there is an imperfect example of an allied but apparently very distinct species, unfortunately without locality. It is more likely to be *M. eumelia*, var.

5. *Moschoneura eumelia*.

Papilio eumelia, Cramer, Pap. Exot. iii. pl. cclxxx. D (1782).

Pieris enodia, Godart, Enc. Méth. ix. p. 166 (1819).

Ega. B. M.

6. *Moschoneura theaphina*, sp. n.

Mimics *Ithomia theraphia** and is allied to *M. ithomia* (which probably mimics *I. kusa*). It can at once be distinguished by the unbroken character of the oblique, postmedian, sulphur-tinted white band on the primaries, which in *M. ithomia* is represented by two unequal spots.

Expanse of wings 45-48 millim.

Ecuador. Coll. Hewitson.

* This species and its allies have been referred to *Scada*, the type of which is *S. phyllodoce*. In the latter species the lower radial of the primaries is given off above the angle of the discocellulars; but this proves to be an inconstant character. It, however, differs from the *alethia* group in that the costal vein is bent downwards towards its distal end so as almost to touch the subcostal, and the angle of the discocellulars of these wings is considerably less pronounced. The types of *Scada* and *Heteroscada* agree in structure, but *fenella* has nothing to do with *H. gazoria*; the name *Heteroscada* thus becomes obsolete.

7. *Moschoneura ithomia*.

Leptalis ithomia, Hewitson, Trans. Ent. Soc. ser. 3, vol. v. p. 562 (1867);
Exot. Butt. iv., *Lep.* pl. viii. fig. 49 (1870).

Ecuador. Type, coll. Hewitson.

DISMORPHIA.

Section ENANTIA, Hübn.

If the characters assigned to *Enantia* were reliable it would be of advantage to use them, as in the case of *Pyrisitia* and *Sphrenogona* (the characters of which are reliable), to break up a somewhat unwieldy genus; but unfortunately they vary not only in individuals of the same species, but to a slight extent on the opposite wings of the same specimen. For a section, the limits of which are somewhat uncertain, the name may perhaps be used in a subgeneric sense.

Group I.

The "species," so called, of this group are very closely related, and, if bred, would probably have to be very greatly reduced; they differ chiefly in the width and form of the dark borders to the wings.

1. *Dismorphia galanthis*.

Leptalis galanthis, Bates, Journ. Entom. i. p. 234 (1861).

Ega : B. M. Amazons and Ecuador : coll. Hewitson.

2. *Dismorphia licinia*.

Papilio licinia, Cramer, Pap. Exot. ii. pl. cliii. E, F (1779).

Papilio phronima, Fabricius, Ent. Syst. iii. 1, p. 206 (1793).

Rio Janeiro : B. M. Cayenne and New Grenada : coll. Hewitson.

3. *Dismorphia lina*.

Papilio lina, Herbst, Natursyst. Schmett. v. p. 75, pl. lxxxix. figs. 3, 4 (1792).

Leptalis dilis, Boisduval, Sp. Gén. Lép. i. p. 427 (1836).

♂, Brazil : B. M. ♂ ♀, Rio Janeiro : coll. Hewitson.

I have very little doubt that this is merely a seasonal variety of the preceding species.

4. *Dismorphia mercenaria*.

Leptalis mercenaria, Felder, Wien. ent. Monatschr. v. p. 76 (1861).

"Venezuela" (Felder). Ecuador: coll. Hewitson.

This may possibly prove to be a wetter phase of *D. galanthis*.

5. *Dismorphia limnorina*.

Leptalis limnorina, Felder, Reise der Nov., Lep. ii. p. 139 (1865).

Rio Janeiro: B. M. Rio Janeiro and Espirito Santo: coll. Hewitson.

6. *Dismorphia aphrodite*.

Leptalis aphrodite, Felder, Reise der Nov., Lep. ii. p. 139 (1865).

Brazil: B. M. Rio Janeiro and Ecuador: coll. Hewitson.

This and the three following will probably prove to be varieties of one species.

7. *Dismorphia isodrita*.

Leptalis isodrita, Boisdual, Sp. Gén. Léop. i. p. 426 (1836).

Brazil (*Boisdual*). ♂ ♀, coll. Hewitson.

8. *Dismorphia Kollari*.

Leptalis Kollari, Lucas, Rev. et Mag. de Zool. 1852, p. 299.

♀. *Dismorphia cretacea*, Grose-Smith, Rhop. Exot. vol. ii., *Dism.* pl. iii. figs. 4, 5 (1897).

♂ ♀, Rio Janeiro. B. M.

9. *Dismorphia acutipennis*.

Enantia acutipennis, Butler, Entomologist, 1896, p. 26.

. *Dismorphia acutipennis*, Grose-Smith & Kirby, Rhop. Exot. vol. ii., *Dism.* pl. iii. figs. 10, 11 (1897).

Trinidad (*Hart*). Type, B. M.

The acutely tipped primaries are badly shown in the illustration.

10. *Dismorphia marion*.

Enantia marion, Godman & Salvin, Biol. Centr.-Am., Rhop. ii. p. 184 (1889).

♀, Nicaragua. Coll. Hewitson.

Group II.

In my opinion the *E. melite* group will eventually be

proved to consist of three variable species at most; but as there is at present no possibility of being certain, I keep them separate.

11. *Dismorphia citrinella*.

♂. *Leptalis citrinella*, Felder, Wien. ent. Monatschr. v. p. 77 (1861).

♀. *Leptalis flavia*, Felder, l. c. p. 76 (1861).

"Venezuela" (Felder). Bogota: B. M. Ecuador: coll. Hewitson.

12. *Dismorphia albania*.

Leptalis albania, Bates, Ent. Month. Mag. i. p. 6 (1864); Godman & Salvin, Biol. Centr.-Am., Rhop. p. 183, pl. lxiv. figs. 27, 28, ♂, pl. lxi. fig. 7 (1889).

Dismorphia amalia, Staudinger, Exot. Schmett. p. 25, "*D. cornelia*," pl. xv. (1884).

♂ ♂ ♀, Mexico: B. M. ♂, hab. ? : coll. Hewitson.

13. *Dismorphia jethys*.

Leptalis jethys, Boisduval, Sp. Gén. Léop. i. p. 423 (1836).

Leptalis cornelia, Felder, Reise der Nov., Lep. ii. p. 140 (1865).

♂ ♀, Mexico: B. M. ♂, New Granada; ♀ ♀, Mexico and Nicaragua: B. M.

I believe the three preceding forms will prove to be variations of one species.

14. *Dismorphia melite*.

Papilio melite, Clerck, Icones, pl. xlv. fig. 5 (1764); Linnæus, Syst. Nat. i. 2, p. 755 (1767).

♂ ♂ ♀ ♀, Rio Grande, Rio Janeiro, and Espiritu Santo: B. M. New Granada, Rio Grande, and Rio Janeiro: coll. Hewitson.

A male in the Museum from Theresopolis and a second in the Hewitson collection seem to be intermediate between this species and *D. jethys*.

15. *Dismorphia theugenis*.

Leptalis theugenis, Doubleday, Ann. & Mag. Nat. Hist. ser. 2, vol. i. p. 124 (1848).

♂ ♂, Peru and Bolivia: type, B. M. Bolivia and Ecuador: coll. Hewitson.

Group III.

16. *Dismorphia thermesia*.

Pieris thermesia, Godart, Enc. Méth. ix. p. 164 (1819).

Leptalis thermesia, Hopffer, Stett. ent. Zeit. 1874, p. 333.

♂ ♂ ♀ ♀, Rio Janeiro, Rio Grande, Venezuela, and Bogota: B. M. Rio Janeiro: coll. Hewitson.

Group IV.

17. *Dismorphia critomedia*.

♂. *Enantia critomedia*, Hubner, Zutr. exot. Schmett. figs. 795, 796 (1832).

♂ ♀, Bogota: B. M. ♀, New Granada; ♂ ♀ ♀, Bolivia: coll. Hewitson.

In the primaries of this species the first subcostal vein is usually emitted a good distance before the end of the cell, but occasionally only just before the end. In the type of the genus (*E. melite*) it is either well before, at, or well beyond the end of the cell.

18. *Dismorphia crisia*.

♀. *Papilio crisia*, Drury, Ill. exot. Ent. iii. pl. xxxvii. figs. 1, 2 (1782).

♂ ♀ ♀, Brazil; ♂ ♀, Espiritu Santo: type, B. M. ♂ ♀ ♀, hab.?: coll. Hewitson.

In this species the first subcostal branch of the primaries seems to be always emitted before the end of the cell. We possess Drury's original type of this butterfly.

19. *Dismorphia fœdora*.

Leptalis fœdora, Lucas, Rev. et Mag. de Zool. 1852, p. 298.

♂ ♂ ♀ ♀, Venezuela. B. M.

In this local representative of *D. crisia* the first subcostal branch of the primaries is emitted either before or at the end of the cell.

20. *Dismorphia virgo*.

Leptalis virgo, Bates, Ent. Month. Mag. i. p. 5 (1864); Godman & Salvin, Biol. Centr.-Am., Rhop. ii. p. 184, pl. lx. figs. 14-16 (1889).

♂. *Dismorphia lubina*, Butler, Cist. Ent. i. p. 83 (1872); Lep. Exot. p. 124, pl. xlv. figs. 6, 7 (1873).

♀. *Dismorphia lunna*, Butler & Druce, Cist. Ent. i. p. 111 (1872); Lep. Exot. p. 124, pl. xlv. figs. 8, 9 (1873).

♀, Chiriqui: B. M. ♂ ♂, Costa Rica and Ecuador: coll. Hewitson.

In this species the first subcostal branch of the primaries is usually emitted well beyond the end of the cell, rarely at the end.

21. *Dismorphia euryope*.

Leptalis euryope, Lucas, Rev. et Mag. de Zool. 1852, p. 297; Godman & Salvin, Biol. Centr.-Am., Rhop. ii. p. 183, pl. lx. figs. 12, 13 (1890).

♂, Mexico; ♀?, Colombia. B. M.

22. *Dismorphia abilene*.

♀. *Leptalis abilene*, Hewitson, Exot. Butt. iv., *Lept.* vii. figs. 51 & 52 (as *L. teresa*, vide corrections) (1872).

♂ ♂ ♀ ♀, Ecuador. ♀ type, coll. Hewitson.

In the Hewitson cabinet the males are separated from the females and labelled "*euryope*"; but they are quite distinct from the insect figured by Hewitson (Exot. Butt. ii., *Lep.* iii. fig. 17, 1858).

23. *Dismorphia medora*.

Leptalis medora, Doubleday, Ann. & Mag. Nat. Hist. xiv. p. 420 (1844); Gen. Diurn. Lep. pl. v. fig. 4 (1847).

Leptalis casta, Kollar, Denkschr. Akad. Wiss. Wien, math.-nat. Cl. i. p. 360, pl. xlv. figs. 9, 10 (1850).

Venezuela, Colombia, Bogota: type, B. M. Ecuador: coll. Hewitson.

A variety (or possibly a local race) occurs also in Ecuador in which the oblique yellow belt of the primaries is replaced by a trifold bilobed oblique bar and a small transverse spot; of this form there is one example in the general series and another in the Hewitson collection.

24. *Dismorphia arcadia*.

Leptalis arcadia, Felder, Wien. ent. Monatschr. vi. p. 410 (1862); Reise der Nov., Lep. ii. p. 141, pl. xxii. figs. 1-3 (1865).

Leptalis idonia, Hewitson, Equat. Lep. p. 5 (1869); Exot. Butt. iv., Lep. pl. vii. figs. 44, 45 (1870).

Both varieties, Bogota: B. M. Ecuador: type, coll. Hewitson.

25. *Dismorphia lucilla*, sp. n.

Leptalis arcadia, Hewitson, in coll.

Nearest to *D. arcadia*, var. *idonia*; the yellow markings on the upper surface of the male much richer in colour

(gamboge rather than lemon-yellow); the spots representing the band on the primaries much more widely divided; the band on the secondaries completely divided on the third median branch and followed by a conical spot with its apex directed towards the outer margin: on the under surface entirely unlike *D. arcadia*, more nearly like *D. medorilla*; the secondaries conspicuously blotched across the centre with bright silvery patches.

Expanse of wings 58 millim.

The female is more like Felder's figure of the female of *D. arcadia* than the male is; it differs above in the streak-like character of the submedian marking on the primaries, in the orange suffusion of the oblique band beyond the cell, and in the distinctly orange wash over the apical portion of the yellow band on the secondaries; the fourth division of this band is completely divided by a brown wedge-shaped bar instead of enclosing a brown spot: the under surface somewhat resembles that sex of *D. medorilla*, but is altogether more yellow, the oblique band of the primaries more orange, and the secondaries conspicuously blotched with silver.

Expanse of wings 61 millim.

Ecuador. Types, coll. Hewitson.

26. *Dismorphia medorina*.

Leptalis medorina, Hewitson, Ent. Month. Mag. xii. p. 9 (1875).

Dismorphia medorina, Grose-Smith & Kirby, Rhop. Exot. ii., *Dism.* i. figs. 9-11 (1896).

Bolivia. Type, coll. Hewitson.

27. *Dismorphia medorilla*.

Leptalis medorilla, Hewitson, Equat. Lep. p. 81 (1877).

Dismorphia medorilla, Grose-Smith & Kirby, Rhop. Exot. ii., *Dism.* i. figs. 4-6 (1896).

Ecuador. Type, coll. Hewitson.

28. *Dismorphia mirandola*.

Leptalis mirandola, Hewitson, Ent. Month. Mag. xiv. p. 180 (1878).

Dismorphia discoloris, Weymer, Stett. ent. Zeit. ii. p. 202 (1890).

Dismorphia mirandola, Grose-Smith & Kirby, Rhop. Exot. ii., *Dism.* i. figs. 7, 8 (1896).

Ecuador. Type, coll. Hewitson.

29. *Dismorphia lua*.

Leptalis lua, Hewitson, Equat. Lep. p. 5 (1880); Exot. Butt. iv., *Lep.* pl. vii. figs. 53, 54 (1870).

Ecuador. Type, coll. Hewitson.

30. *Dismorphia hyposticta*.

Leptalis hyposticta, Felder, Wien. ent. Monatschr. v. p. 77 (1861);
Reise der Nov., Lep. ii. p. 142, pl. xxii. figs. 7, 8 (1865).

♀, "Venezuela" (Felder). ♂, Ecuador: coll. Hewitson.

Group V.

31. *Dismorphia oreas*.

Leptalis oreas, Salvin, Ann. & Mag. Nat. Hist. ser. 4, vol. vii. p. 416
(1871).

Enantia oreas, Godman & Salvin, Biol. Centr.-Amer., Rhop. p. 186,
pl. lx. figs. 17, 18 (1890).

Veragua.

32. *Dismorphia Lewyi*.

♂. *Leptalis Lewyi*, Lucas, Rev. et Mag. de Zool. 1852, p. 296.

♂. *Leptalis nasua*, Felder, Wien. ent. Monatschr. v. p. 76 (1861);
Reise der Nov., Lep. ii. p. 141, pl. xxii. figs. 4-6 (1865).

♀. *Leptalis Kadenii*, Felder, Wien. ent. Monatschr. v. p. 77 (1861).

♂ ♀, Bogota: B. M. ♂ ♂ ♀ ♀, Bolivia: coll. Hewitson.

The females of this species and *D. leonora* vary so much
that it is difficult to believe them conspecific; yet inter-
mediates between the extremes exist.

33. *Dismorphia leonora*.

Leptalis leonora, Hewitson, Equat. Lep. p. 7 (1869); Exot. Butt. iv.,
Lep. pl. v. figs. 39-41 (1870).

♀, Ecuador: B. M. ♂ ♂ ♀ ♀, Ecuador: type, coll.
Hewitson.

34. *Dismorphia Schaussi*.

Leptalis Schaussi, Dognin, Le Nat. 1891, p. 85.

♀, Loja.

Does not this realize one's ideas as to the female of
E. lycosura?

35. *Dismorphia lygdamis*.

Leptalis lygdamis, Hewitson, Equat. Lep. p. 7 (1869); Exot. Butt. iv.,
Lep. pl. v. figs. 32-34 (1870).

♂ ♂ ♀, Ecuador. Type, coll. Hewitson.

36. *Dismorphia lycosura*.

Leptalis lycosura, Hewitson, Exot. Butt. ii., Lep. pl. iv. figs. 18, 20
(1860).

Peru.

I am not sure that the section for which the name *Enantia* was proposed ought not to end here, because at this point the females begin to assume an Ithomeine or Acræine character; but as I desire to leave *Enantia* as understood by its resuscitators (its limitations being purely arbitrary), the following may be included:—

Group VI.

37. *Dismorphia deione*.

♂. *Leptalis deione*, Hewitson, Ent. Month. Mag. vi. p. 63 (1869); Exot. Butt. iv., *Lep.* pl. vi. figs. 37, 38 (1870).

♀. *Dismorphia hayaresa*, Butler, Cist. Ent. i. p. 82 (1872); *Lep. Exot.* p. 124, pl. xlv. fig. 3 (1873).

♂ ♂, Colombia: B. M. ♂ ♂ ♀, Nicaragua: coll. Hewitson.

38. *Dismorphia tapejona*.

♀. *Leptalis tapejona*, Bates, Journ. Entom. i. p. 231 (1861).

♂. *Leptalis zaela*, Hewitson, Exot. Butt. ii., *Lep.* pl. iii. fig. 16 (1858).

♂ ♂ ♀ ♀, Ecuador (type of *D. zaela*). Coll. Hewitson.

39. *Dismorphia laja*.

♀. *Papilio laja*, Cramer, Pap. Exot. iii. pl. ccxxxii. C, D (1779).

"Surinam" (*Cramer*). ♀, Cayenne: coll. Hewitson.

The male of this species cannot differ very greatly from that of *D. tapejona*.

40. *Dismorphia teresa*.

Leptalis teresa, Hewitson, Equat. *Lep.* p. 8 (1869); Exot. Butt. iv., *Lep.* pl. vii. figs. 50–52 (1870).

Leptalis praxidice, Hewitson, Trans. Ent. Soc. 1870, p. 153.

Ecuador. Types, coll. Hewitson.

41. *Dismorphia hippotas*.

Leptalis hippotas, Hewitson, Ent. Month. Mag. xii. p. 10 (1875).

Dismorphia hippotas, Grose-Smith & Kirby, Rhop. Exot. ii., *Dism.* pl. iii. figs. 8, 9 (1897).

Ecuador. Type, coll. Hewitson.

42. *Dismorphia melia*.

♂. *Pieris melia*, Godart, Enc. Méth. ix., Suppl. p. 814 (1828).

♀. *Leptalis eumara*, Doubleday, Ann. & Mag. Nat. Hist. ser. 2, vol. i. p. 122 (1848).

♀. *Leptalis acraeoides*, Hewitson, Trans. Ent. Soc. ser. 2, vol. i. p. 99, pl. xi, fig. 1 (1850).

♀. *Dismorphia mimetica*, Staudinger, Exot. Schmett. p. 25, pl. xv. (1884).

♂ ♀, Theresopolis; ♂ ♂, Brazil: B. M. ♂ ♂ ♀ ♀, Espiritu Santo and Rio Janeiro; ♀, Minas Geraes: coll. Hewitson.

The females vary a good deal in the colouring of the bands across the primaries and the distinctness or otherwise of the black veins.

43. *Dismorphia lysianax*.

Leptalis lysianax, Hewitson, Exot. Butt. ii., *Lep.* pl. iv. fig. 19 (1860).

♀, Upper Amazon. Type, coll. Hewitson.

44. *Dismorphia tricolor*.

Dismorphia tricolor, Grose-Smith & Kirby, Rhop. Exot. ii., *Dism.* pl. ii. figs. 1, 2 (1897).

♀, hab.?

This is a very good copy of a *Eueides* occurring in New Granada.

We now come to the more typical species of *Dismorphia*.

Section DISMORPHIA, Hubn.

Group VII.

45. *Dismorphia carthesis*.

Leptalis carthesis, Hewitson, Trans. Ent. Soc. ser. 3, vol. vii. 1869, p. 71; Exot. Butt. iv., *Lep.* pl. vi. figs. 35, 36 (1870).

Demerara. Type, coll. Hewitson.

46. *Dismorphia aronia*.

Leptalis aronia, Hewitson, Trans. Ent. Soc. ser. 3, vol. v. p. 563 (1867); Exot. Butt. iv., *Lep.* pl. vii. figs. 46-48 (1870).

Quito. Type, coll. Hewitson.

47. *Dismorphia leuconia*, sp. n.

Allied to the preceding species, but differing in the clear greyish-white semihyaline spots on the apical half of the primaries, the paler yellow discoidal streak of primaries and

median belt of secondaries, the latter being broader and shorter than in *D. avonia*.

Expanse of wings, ♂ 50 millim., ♀ 53 millim.

♂♂, Ecuador: B. M. ♂♀, Ecuador: type, coll. Hewitson.

48. *Dismorphia limonea*, sp. n.

♂. Also allied to *D. avonia*, but considerably smaller; the whole of the markings on the primaries sulphur-yellow (rather deeper than in *D. avonia*), the discoidal streak broader; the median belt on the secondaries rather deeper yellow and of more even width, its outer edge being straight.

♀. With all the yellow marks paler than in *D. avonia*; the dark veining on the basal area of the primaries obsolete; the whitish costal streak on the secondaries regular, not terminating in a lobe-like spot.

Expanse of wings, ♂ 39 millim., ♀ 43 millim.

♂♀, Ecuador. Type, coll. Hewitson.

The last three species are so evidently distinct to the eye that it is annoying to discover how little difference in pattern one is able to describe.

49. *Dismorphia theonoe*.

Leptulis theonoe, Hewitson, Exot. Butt. i., *Ent. & Lep.* pl. i. figs. 2, 5 (1852).

♂, Tapajos: type, B. M. ♂♀, Cayenne: coll. Hewitson.

50. *Dismorphia melanoë*.

Leptalis melanoë, Bates, Journ. Entom. i. p. 332 (1861); Trans. Ent. Soc. xxiii. pl. lv. fig. 2 (1862).

♂♂♀♀, São Paulo. Coll. Hewitson.

51. *Dismorphia Ribbei*.

Leptalis Ribbei, Godman & Salvin, Ann. & Mag. Nat. Hist. ser. 5, vol. ii. p. 265 (1878).

Dismorphia Ribbei, iid. Biol. Centr.-Amer., Rhop. ii. p. 178, pl. lxi. fig. 4 (1890).

"Chiriqui" (*Godm. & Salv.*). ♂♂♀♀, Colombia: B. M.

52. *Dismorphia alterata*, sp. n.

Colouring of the preceding species, but the male differs in having a small cuneiform costal patch beyond the middle and

an oblique dash rather larger than that of the female near the outer margin; the female differs in having the band beyond the middle of the primaries uninterrupted; both sexes show hardly a trace of the reddish suffusion on the costa and apical border of primaries below, but quite as much or more bright orange on the secondaries.

Expanse of wings, ♂ 52 millim., ♀ 50 millim.

♂ ♂ ♀, Colombia. Type, B. M.

53. *Dismorphia fortunata*.

♂. *Leptalis fortunata*, Lucas, Ann. Soc. Ent. France, 1854, p. 55, pl. iii. fig. 1.

♂. *Leptalis antherize*, Hewitson, Exot. Butt. ii., *Lep.* pl. iii. fig. 12 (1858).

♂. *Leptalis argochloe*, Bates, Trans. Linn. Soc. xxiii. pl. lvi. fig. 6 (1862).

"Mexico" (Lucas). ♂ ♀, Nicaragua: coll. Hewitson.

54. *Dismorphia leuconoe*.

Leptalis leuconoe, Bates, Journ. Entom. i. p. 232 (1861); Trans. Linn. Soc. xxiii. pl. lvi. fig. 4 (1862).

São Paulo. ♀, coll. Hewitson.

55. *Dismorphia erythroe*.

Leptalis erythroe, Bates, Journ. Entom. i. p. 232 (1861); Trans. Linn. Soc. xxiii. pl. lvi. figs. 1-3 (1862).

"São Paulo." ♂, Amazon: B. M. ♂ ♀, coll. Hewitson. Hewitson has a slight variety from Ecuador.

56. *Dismorphia flammula*, nom. n.

Leptalis theonoe, var., Bates, Trans. Linn. Soc. xxiii. pl. lv. fig. 4 (1862).

♀, Ega: B. M. Amazon: coll. Hewitson.

If this and the following are varieties, they must be tolerably constant and frequent ones; but it appears to me that whereas *D. erythroe* copies *Leucothyris ilerodina*, *D. flammula* more nearly resembles *Hymenitis sarapta*, and that whereas *D. fervida* is a copy of *Leucothyris priscilla*, *D. lysinoe* is stated by Bates himself to be "quite unlike any *Ithomia* found in the whole region," and he regards it as a mimic of *Stalachtis Duvakii*. It is hardly probable that mere sports of the same species would be formed in imitation of species belonging to different families or even different genera.

57. *Dismorphia fervida*, nom. n.

Leptalis theonoe, var., Bates, Trans. Linn. Soc. xxiii. pl. lv. fig. 6 (1862).

♀ ♀, Ega. B. M.

58. *Dismorphia lysinoe*.

Leptalis lysinoe, Hewitson, Exot. Butt. i., *Eut. & Lep.* pl. i. figs. 3, 4 (1852).

♂ ♂ ♀ ♀, Ega: B. M. ♂ ♀ ♀, Amazon: type, coll. Hewitson.

59. *Dismorphia lysinoides*.

♀. *Dismorphia lysinoides* (as ♂), Staudinger, Exot. Schmett. p. 25, pl. xv. (1884).

"Cauca" (*Staudinger*).

Very close to *D. lysinoe*, but with wider transparent areas to the wings. If all the preceding species are to be regarded (in the Batesian fashion) as varieties of *D. theonoe*, Staudinger's species is hardly worthy to be called a sport; but I cannot believe in such improbable variability in any species unless it can be shown to have a seasonal value.

60. *Dismorphia siloe*.

Leptalis siloe, Hewitson, Exot. Butt. ii., *Lep.* pl. iii. fig. 14 (1858).

♂, New Granada. Type, coll. Hewitson.

The following species and others described with it were incorrectly referred to in Grose-Smith and Kirby's 'Rhopalocera Exotica' as "Butler, MS." They had then been published quite fifteen months.

61. *Dismorphia nella*.

Dismorphia nella, Butler, Entom. 1896, p. 26; Grose-Smith & Kirby, Rhop. Exot. ii., *Dis.* pl. ii. figs. 6-8 (1897)

♂, Bogota: type, B. M. ♂ ♂ ♀ ♀, New Granada: coll. Hewitson.

62. *Dismorphia theucharila*.

Leptalis theucharila, Doubleday, Ann. & Mag. Nat. Hist. ser. 2, vol. i. p. 123 (1848); Hewitson, Exot. Butt. i., *Eut. & Lep.* pl. i. figs. 6-8 (1852).

♂ ♀ ♀, Venezuela: type, B. M. ♂ ♀, coll. Hewitson.

Here follows a little group of species having somewhat the colouring of the more typical forms of the section *Enantia*, but which I believe to be related to the *D. theucharila* and *D. rhetes* groups, to which the outline of the wings apparently allies it.

Group VIII.

63. *Dismorphia pimpla*.

Leptalis pimpla, Hopffer, Stett. ent. Zeit. 1874, p. 333.

♂ ♂ ♀ ♀, Bolivia. Coll. Hewitson.

64. *Dismorphia lelex*.

♂. *Leptalis lelex*, Hewitson, Equat. Lep. p. 6 (1869); Exot. Butt. iv., Lep. pl. v. fig. 24 (1870).

♀. *Leptalis zathoe* (*L. lelex* ♀ in text), Hewitson, Exot. Butt. iv., Lep. pl. v. fig. 25 (1870).

♂ ♂ ♀ ♀, Ecuador. Type, coll. Hewitson.

65. *Dismorphia proserpina*.

Dismorphia proserpina, Grose-Smith & Kirby, Rhop. Exot. ii., *Dism.* pl. iii. figs. 1-8 (1897).

"Roraima" (*Grose-Smith*). ♂ ♂ ♀ ♀, not labelled: coll. Hewitson.

The description of this species states that the lighter parts of the wings are "primrose-yellow"; this corresponds with the examples in the Hewitson collection. The figures represent these parts of the wings as milky whitish and the male with a brown subcostal patch as in *D. pallidula*. Has the wrong species been figured, or is the colouring defective?

66. *Dismorphia pallidula*.

Dismorphia pallidula, Butler, P. Z. S. 1874, p. 363; Godman & Salvin, Biol. Centr.-Amer., Rhop. ii. p. 176, pl. lx figs. 9-11 (1890).

♂ ♀, Colombia: B. M. ♂, Costa Rica: coll. Hewitson.

67. *Dismorphia othoe*.

Leptalis othoe, Hewitson, Trans. Ent. Soc. ser. 3, vol. v. p. 562 (1867); Exot. Butt. iv., Lep. pl. v. figs. 26-28 (1870).

♂, Ecuador: B. M. ♂ ♂ ♀ ♀, coll. Hewitson.

68. *Dismorphia zathoe*.

♂. *Leptalis zathoe*, Hewitson, Exot. Butt. ii., *Lep.* pl. iii. fig. 15 (1858).
Leptalis core, Felder, Wien. ent. Monatschr. v. p. 77 (1861).

♂, Bogota: type, B. M. ♀, New Granada: coll. Hewitson.

69. *Dismorphia lysis*.

Leptalis lysis, Hewitson, Equat. Lep. p. 6 (1869); Exot. Butt. iv., *Lep.* pl. v. figs. 29-31 (1870).

♂ ♂ ♀ ♀, Ecuador. Type, coll. Hewitson.

Group IX.

70. *Dismorphia rhetes*.

Leptalis rhetes, Hewitson, Exot. Butt. ii., *Lep.* pl. ii. fig. 9 (1857).

"Colombia" (*Boisduval*).

The following seems extremely close to *D. rhetes*; but as we only have a single example, it is impossible to say whether or not it is absolutely constant to pattern:—

71. *Dismorphia Hewitsoni*.

Dismorphia Hewitsoni, Kirby, Trans. Ent. Soc. 1881, p. 355; Grose-Smith & Kirby, Rhop. Exot. ii., *Dism.* pl. ii. figs. 9-11 (1897).

Ecuador. ♂ type, coll. Hewitson.

Group X.

72. *Dismorphia orise*.

Leptalis orise, Boisduval, Sp. Gén. Lép. i. p. 415 (1836); Hewitson, Exot. Butt. ii., *Lep.* pl. ii. figs. 10, 11 (1857).

♂, Tapajos: B. M. ♂, Ecuador; ♂ ♂ ♀, not labelled: coll. Hewitson.

73. *Dismorphia sororna*.

Dismorphia sororna, Butler, Cist. Ent. i. p. 82 (1872); *Lep.* Exot. p. 122, pl. xlv. figs. 1, 2 (1873).

Costa Rica.

Allied to *D. cordillera*.

74. *Dismorphia myris*.

Dismorphia myris, Godman & Salvin, Biol. Centr.-Amer., Rhop. ii. p. 178 (1889).

Costa Rica and Panama.

Closely allied to *D. cordillera*.

75. *Dismorphia cordillera*.

Leptalis cordillera, Felder, Wien. ent. Monatschr. vi. p. 400 (1862); Reise der Nov., Lep. ii. p. 145, pl. xxii. fig. 11 (1865).

♂, Bogota: B. M. ♀, not labelled: coll. Hewitson.

76. *Dismorphia larunda*.

Leptalis larunda, Hewitson, Equat. Lep. p. 4 (1869); Exot. Butl. iv Lep. pl. vi. figs. 42, 43 (1870).

♂ ♂ ♀, Ecuador. Type, coll. Hewitson.

Group XI.

77. *Dismorphia discrepans*.

♂. *Dismorphia discrepans*, Butler, Entom. 1896, p. 26.

♂, New Granada. Type, B. M.

Var. with yellow markings of primaries confluent.

♂ ♀, New Granada. Coll. Hewitson.

78. *Dismorphia rhomboidea*.

♂. *Dismorphia rhomboidea*, Butler, Entom. 1896, p. 27; Grose-Smith & Kirby, Rhop. Exot. ii., *Dism.* pl. ii. figs. 3-5 (1897).

♂, "Nauta" = E. Peru: type, B. M. ♀, not labelled: coll. Hewitson.

As already stated in the 'Entomologist,' it is probable that the female of this species and other unlabelled examples in the Hewitson collection formed part of Buckley's Ecuador series.

79. *Dismorphia arsinoe*.

Leptalis arsinoe, Felder, Reise der Nov., Lep. ii. p. 143, pl. xxii. figs. 9, 10 (1865).

♂ ♀, New Granada. Coll. Hewitson.

80. *Dismorphia amphione*.

Papilio amphione, Cramer, Pap. Exot. iii. pl. cccxxii. E, F (1782).

♂ ♀, Brazil: B. M. ♀, coll. Hewitson.

81. *Dismorphia beroe*.

Leptalis beroe, Lucas, Rev. et Mag. de Zool. 1852, p. 295.

"Bogota" (Lucas).

I have seen nothing which quite answers to the description of this species.

82. *Dismorphia egaena*.

Leptalis egaena, Bates, Journ. Entom. i. p. 230 (1861); Trans. Linn. Soc. xliii. pl. lvi. fig. 7 (1862).

♂ ♂ ♀ ♀, Ega: B. M. ♂ ♂ ♀, Amazon: coll. Hewitson.

83. *Dismorphia Broomeae*, sp. n.

♂. Allied to *D. egaena*, but the longitudinal trifold streak on the primaries divided by the median vein bright fiery orange, more sharply defined than in *D. amphione*; the oblique postmedian band bright yellow, washed in the centre with bright orange, the discocellular black marking crescentic, the last division of the band completely separated, forming an elongated oval spot; the three subapical spots forming a regular oblique series, smaller and more widely separated from the postmedian band than in *D. egaena*, but less so than in *D. amphione*; the white patch on the secondaries purer than in *D. egaena* and the oblique belt from abdominal margin bright fiery orange.

The female differs from that sex of *D. egaena* in its altogether brighter colouring (more like that of *D. amphione*), in the narrower tawny-washed oblique band on the primaries, with small discocellular black spot and divided terminal yellow spot.

Expanse of wings, ♂ 65 millim., ♀ 70 millim.

♂ ♂, Trinidad (*Lady Broome and J. H. Hurt*); ♂ ♀ ♀, Venezuela (*Dyson*): B. M. ♂ ♂, Caraccas: coll. Hewitson.

Local form? ♂ ♀ ♀, Ecuador: coll. Hewitson.

84. *Dismorphia praxinoe*.

♀. *Leptalis praxinoe*, Doubleday, Ann. & Mag. Nat. Hist. xiv. p. 419 (1844).

Leptalis amphithea, Felder, Reise der Nov., Lep. ii. p. 144 (1835).

Dismorphia arsinoides, Staudinger, Exot. Schmett. p. 25 (*arsinoe*), pl. xv. (1884).

♂ ♀ ♀, Mexico (type); ♂, Colombia: B. M. ♂ ♀, Nicaragua: coll. Hewitson.

85. *Dismorphia Perrensi*.

Leptalis Perrensi, Gosse, Entom. xiii. p. 195 (1880).

♂ ♂, Rio Grande: B. M. ♂ ♂, not labelled: coll. Hewitson.

86. *Dismorphia astyocha*.

Dismorphia astyocha, Hübner, Zutr. exot. Schmett. figs. 485, 486 (1825).

♂ ♂, Espiritu Santo, Brazil; ♀ ♀, Organ Mountains, Rio Janeiro: B. M. ♂ ♀ ♀, Rio Janeiro: coll. Hewitson.

87. *Dismorphia astynome*.

Leptalis astynome, Dalman, Anal. Ent. p. 39 (1823).

Dismorphia polymela, Hübner, Zutr. exot. Schmett. figs. 723, 724 (1832).

♀ ♀, Brazil: B. M. ♂ ♂ ♀ ♀, Rio Janeiro: coll. Hewitson.

Group XII.

88. *Dismorphia eunoe*.

Leptalis eunoe, Doubleday, Ann. & Mag. Nat. Hist. xiv. p. 419 (1844); Gen. Diurn. Lep. pl. v. fig. 3 (1847).

♀, Oaxaca, Mexico. Type, B. M.

89. *Dismorphia cubana*.

Leptalis cubana, Herrich-Schaffer, Corresp.-Blatt zool.-mineral. Ver. Regensb. xvi. p. 120 (1862).

Dismorphia cubana, Gundlach, Cont. Ent. Cubana, p. 81 (1881); Grose-Smith & Kirby, Rhop. Exot. ii., *Dism.* pl. i. figs. 1-3 (1890).

Leptalis spio, var. *a*, Boisduval, Sp. Gén. Lép. i. p. 421 (1836).

Cuba.

90. *Dismorphia spio*.

Pieris spio, Godart, Enc. Méth. ix. p. 167 (1819).

Leptalis spio, Hewitson, Exot. Butt. ii., *Lep.* pl. iv. figs. 21-23 (1860)

♂ ♂ ♀, St. Domingo. B. M.

Genus ACMEPTERON.

Although this genus was founded upon a secondary sexual character which is not absolutely constant, it contains species having an outline of wing differing to a certain extent from anything else in the genus. The subcostal vein of the

secondaries in the male more often than not emits its first branch before or at the end of the cell, but not infrequently the two branches fork from a short footstalk beyond the cell, as in the female.

I have little doubt that this group of species branched off from *Dismorphia* as a development from *D. nasua* and allies, which curiously approach it in coloration and somewhat in outline of wing.

1. *Acmepteron atthis*.

♀. *Leptalis atthis*, Doubleday, in Gray's Zool. Misc. p. 75 (1842).

♂. Very like *A. nemesis*, but without the yellow veins and streaks on basal half of primaries; the yellow patch on secondaries narrower, owing to the presence of a dark brown dentate-sinuate border which extends along the outer margin to the submedian vein.

Expanse of wings 67 millim.

♂ ♂ ♀ ♀, Mexico. B. M.

This is the species figured as *Dismorphia nemesis* by Staudinger (Exot. Schmett. pl. xv.).

2. *Acmepteron nemesis*.

Pieris nemesis, Latreille, in Hombon & Bonpland's Obs. Zool. ii. p. 78, pl. xxxv. figs. 7, 8 (1811-19).

♂ ♂, Venezuela, Bogota, Colombia, Bolivia, E. Peru: B. M. ♂ ♂ ♀ ♀, Ecuador: coll. Hewitson.

3. *Acmepteron viridifascia*.

Dismorphia viridifascia, Butler, Cist. Ent. i. p. 83 (1872); Lep. Exot. p. 123, pl. xlv. figs. 4, 5 (1873).

Costa Rica.

4. *Acmepteron cinerascens*.

Leptalis cinerascens, Salvin, Ann. & Mag. Nat. Hist. ser. 4, vol. vii. p. 415 (1871).

Acmepteron cinerascens, Godman & Salvin, Biol. Centr.-Amer., Rhop. ii. p. 180, pl. lx. fig. 8 (1889).

Costa Rica.

5. *Acmepteron lala*.

Acmepteron lala, Godman & Salvin, Biol. Centr.-Amer., Rhop. ii. p. 181, pl. lxiv. figs. 25, 26 (1889).

Guatemala.

LIV.—*Podocerus and Jassa of Leach.*

By ALFRED O. WALKER.

MR. STEBBING'S unrivalled knowledge of the literature of the Amphipoda and the careful accuracy of his work are so well known that a corroboration of the conclusion he arrived at in the paper in the March number of this Journal, viz. that the true *Podocerus* of Leach is *Platophium Darwinii* (Bate), is scarcely needed. Nevertheless, as the revolution in nomenclature caused by this discovery is so serious that persons may be found who will object that something more is required to support it than Milne-Edwards's admittedly inaccurate description and figures, I venture to offer the following evidence. Having ascertained, by examination of Leach's type specimen last October, that *Jassa pelagica*, Leach, was not the female of *Podocerus falcatus* (Mont.), but was (to use G. O. Sars's name) *Janassa capillata* (Rathke), I was led to undertake an examination of the history of the genus *Podocerus*, in which I have always taken a special interest. I was of course not aware that Mr. Stebbing was doing the same. I arrived substantially at the same conclusions as Mr. Stebbing, but, unlike him, was unable to identify Milne-Edwards's description and figure with any known Amphipod, as I could not suppose him to have invented the dorsal teeth on the three segments. I therefore postponed the conclusion of a paper I had written on the subject till I could again examine the type specimens of *Podocerus variegatus*, Leach, at the British Museum. This was delayed through a visit of six weeks to the south of France, and it was only in passing through London on my way home in the middle of March that I was able to do so with the kind assistance of Mr. R. I. Pocock. Neither he nor I then knew of Mr. Stebbing's paper, so that the opinion we both formed was absolutely unbiassed.

The type specimens, of which there are several, are either pierced with a pin or gummed on a piece of card. There are at least two species among them, one being apparently the female or young of *P. falcatus* (Mont.). The other, however, we had no difficulty in deciding to be the species Milne-Edwards intended to represent *minus the dorsal teeth*. The antennæ, fortunately, are nearly perfect, and though the first gnathopods are either gone or hidden, yet the second gnathopods, a first or second peræopod, and one or two of the last peræopods still remain. Mr. Pocock and I agreed that these corresponded with *Platophium*; but having Sars's figure of *Latmatophilus* (*Platophium*) *tuberculatus* (Bruz.) before us,

and supposing him to be right in uniting *Cyrtophium Darwinii*, Bate, with that species, we were not satisfied with the identity of the specimen. It seems, however, that Sars was in error in uniting these two species; and when, on reaching home a few days later, I had an opportunity of examining specimens of *C. Darwinii* from the Devonshire coast, I had no longer any doubt of their identity with the British Museum specimen. It is therefore clear that Milne-Edwards's *P. variegatus* is *Platophium Darwinii* (Bate); and as it agrees in its prominent eyes and the apparently nearly straight side of the head of the second gnathopods with Leach's description much more closely than does *P. fulcatus* (Mont.) ♀, the conclusion arrived at by Mr. Stebbing seems irresistible.

As regards the question Mr. Stebbing raises, whether *Jassa falcata* (Mont.) should be superseded by *Jassa pulchella*, Leach, on the ground that the former species "remains . . . indeterminate," I am "bold" enough to say that I have no doubt that Montagu's species is the immature male of Leach's *Jassa pulchella*. As the author of *Podocerus Herdmani* (*P. odontonyx*, G. O. Sars), I can hardly be suspected of a bias in the direction of destroying that species; yet the experience gained since it was established has satisfied me that neither size nor the depth of water at which a species may have been taken are characters of any value. For instance, the largest specimen of *Jassa falcata* (Mont.) in my collection (an adult male measuring 10 millim. in length) was taken in 50 fathoms off Holyhead, while I have specimens of the so-called *P. Herdmani* from quite shallow water. The above large specimen has a distinct tooth on the dactylus, and I have specimens with the tooth of various degrees of prominence. The length of Montagu's specimen is given as 5 lines (say 10 millim.), but as he gives the length of *Gammarus locusta*, Linn., in the same paper as 1 inch (25 millim.), which is not only longer than the largest specimen I have from these coasts, but also than the maximum size given by Sars (20 millim.) for specimens from the Norway coast, it is quite possible that he may have included the antennæ in his measurement. I will therefore conclude by expressing a hope that the time-honoured specific name of *falcata* (Montagu) may be spared to us in the general wreck of the Podoceridæ.

Colwyn Bay,
April 5, 1899.

LV.—Notes on the Faculty of Changing Colour in Reptiles.
By P. DE GRIJS*.

UNDER the heading "Briefliche Mittheilungen" in no. 9 of the last annual volume of 'Der Zoologische Garten' there appears a communication from Dr. A. Hanau on the coloration of the interstitial integument in *Tropidonotus ordinatus*, var. *sirtalis*. On reading the lines in question the thought involuntarily occurred to me how little, after all, any observations are capable of enlightening us as to the causes and efficacy of so many phenomena in the animal kingdom. As the gentleman referred to will undoubtedly have remarked, the question in the case of *T. ordinatus* and all other species which have a brightly coloured or marked interstitial integument is not of a power of changing colour, but of fixed colours, which when the body of the snake is not distended remain invisible owing to the closely approximated scales. All the species of snakes that I have hitherto observed possessed no trace of a power of changing colour, such as is found in many other reptiles and batrachians; I have never read that snakes possessing the power of changing colour have been observed, and I think that I shall not be wrong in absolutely denying to this order the faculty of sudden alteration of hue. Now what can be the reason that no single snake possesses the power of changing colour? To these animals, as protection against enemies or for the purpose of stealing upon their prey, a change of colour would in many cases be of just as great advantage as to many Lacertilia. Leaving out of the question the poisonous snakes, which are sufficiently protected from attacks by their bite, there still remains the great multitude of non-poisonous species, which have many enemies. It is true that many non-poisonous snakes possess great activity and swiftness; but the same qualities are likewise shared by a large portion of the Lacertilia which are able to change colour. I content myself with having raised the question; it would be interesting to bring about an exchange of opinions on the subject. The fact that crocodiles and Chelonians are devoid of the power of changing colour cannot reasonably create astonishment; nature has furnished these creatures with sufficient equipment for defence. But that among the snakes there are no species at all with a more or less developed power of changing colour is a fact that must attract our attention. We

* Translated by E. E. Austen from 'Der Zoologische Garten,' xl. Jahrg. no. 2 (1899), pp. 49-55.

might well ask why it is that, in the struggle for existence, no species of snake has been produced with a skin similar in constitution to that of the Lacertilians which change their hue. It may be that the constitution of the integumentary coverings and of the skin itself is of such a kind that a different arrangement of the pigment-cells cannot take place. In order to decide the question it would be necessary in the first place to determine what are the qualities in respect of which the skin of reptiles which change their colour differs fundamentally as regards anatomy from that of those not endowed with this faculty. After that we might perhaps hope to acquire information as to the reason why a large number of lizards and all snakes are without the power of changing colour.

In the Lacertilia the external constitution and covering of the skin does not allow us to infer with certainty the possession of the power of changing colour. It is true that, generally speaking, it may be stated that lizards with a porous integumentary covering (those that become wet if placed in water) frequently possess the power of changing colour, and that those with non-porous scales (from these water drips off as from a greasy object) have none; but there are exceptions to both categories. Most of the Lacertilia that change their colour are distinguished by having small non-imbricated scales; but here also there are exceptions, and, on the contrary, many fine-scaled Lacertilia cannot change colour. It is consequently impossible to set up any definite rules, and to undertake a description of the coloration of Lacertilia based upon spirit-specimens has therefore only a conditional value. It is true that the Lacertilians which change colour generally assume the same coloration in death, so that it is possible to determine spirit-specimens. An attempt, however, to determine species of *Anolis*, for example, from descriptions of colour alone would scarcely lead to a definite conclusion as to the classification of a species.

The power of changing colour in Lacertilia differs greatly—on the one hand as regards intensity and frequency, on the other in respect of the purposes which it serves.

Whether, after all, in the case of *Lacerta agilis*, *viridis*, and *muralis* we would regard as the faculty of changing colour the regular alteration of hue in spring or at the pairing-season of the species inhabiting temperate zones is a question that may remain undecided; it is true that it does not depend upon the will of the creatures themselves, but neither can it be compared with the alteration of colour in mammals and birds. At any rate I am of opinion that here

also there ensues a movement of the pigment-cells, which certainly is quite slow, but nevertheless analogous to that which takes place in the creatures which are capable of changing colour quickly. This view is supported by the fact that also in the case of the Lacertilia which change their colour in the course of quite a short space of time the will is not always active, but, on the contrary, external influences compel the animal to change its colour. A chameleon that has been exposed for a time to great heat always becomes bright yellow.

The intensity of the colour-change differs extremely in the different species. In the first instance two groups can be established:—

I. Ground-colour and marking alter equally in tone, but the marking does not disappear.

II. Ground-colour and marking each alter in tone independently of the other; spots may entirely disappear.

To the former group belongs, for instance, *Eumeces Schneideri*. Under the influence of heat this species always appears quite bright greyish yellow, with bright yellowish-red spots. In an unheated cage the animal assumes a dark greyish-brown colour, and the spots appear brick-red. Of the lizards that I have kept I also assign to this group *Tarentola annularis*, which varies from blackish brown to bright sand-colour, with constant marking; *Uromastix*, which likewise appears lighter under the influence of heat; *Sceloporus undulatus*, the upper surface of which assumes a considerably brighter tone under the influence of the sun's rays; *Crotaphytus collaris*, a species which, when the temperature is low, appears dusky grey, while in heat the head becomes almost white, the body bluish grey, the feet appear shining bluish green, and the tail becomes bluish white, but all markings composed of spots remain constant; besides these there are *Phrynosoma cornutum* and *Amphibolurus barbatus*, both of which become brighter under the influence of heat, various species of ground Agamæ (*Agama mossambica* and *A. stellio*), as also *Cachryx defensor*, of which the body-colour passes from blackish grey to light blue, while the marking of spots remains unaltered.

To the second group belong, among others, *Anolis*, *Agama sanguinolenta* and *A. inermis*, *Phrynocephalus*, *Iguana*, *Calotes*, and *Chamæleon*. *Chamæleon* really forms a group by itself, since its power of changing colour materially exceeds that of all other species. In the species mentioned there consequently takes place a double change of colour in a more or less pronounced degree, in so far as ground-colour and spots

can each undergo a change of hue independently of the other. Taking the body as a whole, the number of different colorations which *Chamaeleon*, in particular, is able to assume becomes in this way very large. Moreover, at least in *Iguana*, *Calotes*, and *Chamaeleon vulgaris* (not in all varieties), the spots may entirely disappear, which is never the case in the species of the first group. It is, however, important to draw attention to the fact that, so far as my experience extends, no reptile that changes colour possesses the faculty of allowing alterations to take place in the outlines of the spots. Since the changes of tint recur with a certain regularity, it is after continued observation very easy to determine that ground-colour and spots always show precisely the same limitations so long as the animals do not appear of one colour. If we have once determined these limitations we shall find that no other pattern is ever produced under all gradations of tint; the spots always occur in precisely the same part of the body and have the same size and outline. Besides the faculty of changing its ground-colour and the colour of its spots independently of each other, *Chamaeleon* also possesses the power of producing another kind of marking. This marking consists in the entire body of the animal appearing as if strewn with numerous roundish black specks. The broad circle of the eyelid is then seen to be coloured in radii. This coloration only occurs when the animal is alarmed, and here also the number and arrangement of the spots are, as I have convinced myself, always the same.

It would lead us too far to give an enumeration of all possible changes of colour in the different species. Observation shows, however, that they recur with a certain regularity, and consequently must also have a definite object.

So far as it is possible to recognize this object, several divisions can again be set up, according to which the power of changing colour can be classified.

In the sense of the Darwinian theory, the power of changing colour may have arisen, or, let us say, have been developed:—

- I. For the purpose of protection against enemies.
- II. As a means of absorbing or warding off heat.
- III. Through sexual selection.

While in the case of some of the reptiles which change colour only one of the objects named is to be recognized, in others the change of hue fulfils two or even all of the purposes referred to.

It is to be regarded as protective coloration when *Agamæ* and *Geckos* assume the tint of the ground or bark so precisely as scarcely to be distinguished from the surface on

which they rest. The change of colour of the species of *Anolis* undoubtedly serves these animals in the first place for protection. That the change of colour in *Anolis* is partly spontaneous I was able to determine with certainty from specimens that I kept in captivity; for so long as I kept various examples of *A. principalis* in a vivarium destitute of plants it was only rarely and only under the influence of sunshine that the animals assumed the splendid green colour. Since, however, I have allowed the lizards to run about freely in a glazed verandah full of plants they are almost continually green, and this even when the sky is overcast. The change of colour in the chamæleon also serves the almost helpless animal preeminently for protection, for, as a Spanish proverb has it, "a chamæleon seen is a chamæleon lost"! It is an interesting fact that the power of changing colour in *Chamæleon vulgaris* has apparently adapted itself to the localities whence the specimens are obtained. Examples from places poor in vegetation are unable to produce the beautiful blue-green tints which are assumed by those coming from districts in which plants abound. Some years ago I received some extremely vividly coloured specimens of this kind which I was at first inclined to regard as belonging to a distinct species. I was not told where they had been found, and no such specimens have since come under my notice.

The coloration of *Iguana tuberculata* is also protective. It is true that in this species it is only variations from light and dark green that are possible; markings consisting of spots may either appear or disappear. The change of colour in *Iguana* seems to be more pronounced in young than in old animals; yet I have not sufficient experience as to this, since it was only quite a young individual that I was able to observe more closely.

That some species spontaneously utilize their power of changing colour in order to absorb or to ward off heat is perhaps of more subordinate importance. It is probably a matter of general knowledge that in cool weather *Chamæleon vulgaris* becomes almost black on the side on which the sun's rays fall. If the same species be exposed to great heat it becomes bright yellow. A specimen of *Amphibolurus barbatus* that I have been keeping for a long time turns a perfectly dark colour in the morning, when the first rays of the sun fall into its cage; at midday it is pale grey, and with continuous sunshine the head is almost white. Most of the Agamidæ and Iguanidæ, which inhabit the deserts and steppes, become paler under great heat.

Of much greater importance, on the other hand, is the

change of colour that takes place in many lizards in the male sex for the purpose of exercising an attraction over the females at the pairing-season. The occurrence in the Lacertilia of a power of changing colour in this direction is already in itself a proof of the higher development of these animals as compared with the snakes. Among the Ophidia we find little divergence in the colour of the sexes and in the shape of the body, indeed, apart from the length of the tail, scarcely any difference at all. In the Lacertilia, on the contrary, the difference between the sexes is frequently very strongly marked; I need only allude to the throat-sacs and crests.

Well-known examples of the power of changing colour which have probably arisen through sexual selection are afforded by *Agama inermis* and *Sceloporus undulatus*. In respect of the Darwinian theory these species are so much the more interesting in that in them, simultaneously with the colour-changing faculty, quite peculiar habitual movements have been developed. In order to remain invisible to the eyes of their enemies—probably in the majority of cases birds—when looked at from above it was necessary that the change of colour should be confined to the throat and sides of the belly. Lest, however, the beauty of their woosers should escape the glances of the females, the former had to adopt their peculiar nodding and bobbing up and down movements, in order to render their chief adornment visible. The splendid blue coloration of the throat and sides of the belly in *Agama inermis* and *Sceloporus undulatus* is, moreover, not so much spontaneous as dependent on the temperature. In the case of *Agama* the blue colour disappears entirely in cool weather or persists upon the throat only in the form of a blackish marbling; in *Sceloporus* during cold the blue passes into black, but generally allows a blue metallic sheen to be detected. I am not aware whether *Chamæleon* arrays itself in especially vivid colours at the breeding-season. I am inclined to think, however, that the species employs its peculiarly well-developed power of changing colour also as a means of attracting the female sex; and I do so because the extremely quarrelsome males at once assume vivid colours on catching sight of one another.

Our knowledge of colour-change in Lacertilia is probably exceedingly small in comparison with that which has still to be discovered. Most of the species which change colour are small and delicate animals that never reach Europe alive at all. That the large powerful species are less in need of a protection derived from colour is evident; they will therefore, in the majority of cases, have fixed colours. Anyone who

looks through a collection of smaller lizards preserved in alcohol will scarcely gain an idea of the splendour of colour that many of the faded carcasses may exhibit in life. At any rate, for the purpose of an exhaustive study of Lacertilia the observation of living material can be much less easily dispensed with than in the case of the Ophidia. It would therefore be desirable that such zoological gardens as seek to advance science should direct their attention more than hitherto to the importation of the first-mentioned animals. With the commercial relations that Germany possesses a successful result should not be difficult of attainment, and should scarcely entail any considerable monetary sacrifice.

LVI.—*The Poisonous Snakes of British Guiana.*

By J. J. QUELCH, B.Sc. (Lond.), C.M.Z.S.*

IF an ordinarily well-informed person be questioned as to the abundance or paucity of poisonous snakes in the Colony, no doubt the answer would deal rather with swarms than with a few, with the implication not only of numbers of any one particular kind, but also of many different species. And yet, as a fact, there are only about eight well-marked different species, of which two pit-vipers only are of such common occurrence as to present some element of dread to general travellers. In the open savannahs or cleared lands and on the sparsely clumped sandy wastes the rattlesnake is likely to be encountered, while in the forest itself or adjoining lands the labarria (known variously in different districts as Jararaca or Fer-de-lance) takes its place.

Of the remaining six species two are pit-vipers and four coral-snakes; but while, from their general size and character, the pit-vipers and one of the coral-snakes are certainly to be feared if met with, the other three seem to be usually altogether inoffensive creatures, and, in fact, much less ready or more disinclined to bite if irritated or handled than the generality of the common harmless snakes.

In using the term poisonous snakes it must be understood to refer only to those special forms which, from the perfection of the poison-apparatus, are able to cause serious injury or death to man and other large mammals. Such are the vipers and those members of the Colubrine division which bear

* From 'Timehri: the Journal of the Royal Agricultural and Commercial Society of British Guiana,' vol. xii. part i., new ser., 1898, pp. 26-36.

anterior, grooved, or perforated fangs in connexion with the poison-glands. The members of a very large section of what are commonly termed harmless snakes are, however, really poisonous to a certain extent, possessing grooved *posterior* fangs, the bite from which is capable of paralyzing or killing the small prey on which they feed. On man this bite produces, at any rate in certain cases, an effect quite independent of the mechanical injury. This the writer personally experienced in the case of the common species of *Erythrolamprus* (*E. aesculapii*=*E. venustissimus*), as recorded in 'Timehri,' vol. vi. new series (1892), p. 174. Three bites from the snake were received on the first finger, the posterior fangs being driven down deeply into the flesh each time, and after a short interval very considerable swelling and severe pain resulted, which was only relieved after about four hours, though the place was tender for a much longer time.

A similar effect on man is certainly produced by the bite of some Colubrine snakes which are destitute of grooved teeth. This has been directly noted by the writer in the case of two species with enlarged elongated posterior teeth, namely *Xenodon severus* and *Helicops angulatus*, where the teeth were driven deeply down into the flesh, and it would appear that ill effect is only caused by a large wound of a great degree of penetration admitting matter from the buccal glands, which would be impossible in a bite of slight or only moderate depth. An interesting relation between the two groups is seen in forms of the common species of *Erythrolamprus*, in which certain specimens are destitute of the groove on the posterior fangs.

The foregoing cases may serve to explain the peculiarity of the very large number of instances in which persons have been said to have been bitten by the common forest pit-viper or labarria and have recovered, and the extreme simplicity of the remedies used, such, for instance, as sugar and salt, paraffin oil, onion poultice, external application of ammonia, and other such substances, some of which may certainly be efficacious in allaying pain and lessening inflammation, but would have no real effect in dealing with a case of a lethal dose of snake-poison, especially after the more or less long intervals which usually elapse before such applications can be made. In certain cases, no doubt, the snakes may have been labarrias whose glands may not have been fully charged and whose bite would therefore not inject sufficient poison to kill; but in the great majority of cases it may be taken for granted the snakes were really not deadly, though perhaps capable of producing a certain amount of inflammation and more or less

severe pain by means of the enlarged posterior maxillary teeth, whether grooved or not.

To those who have an exact knowledge of snake-structure the matter is simple enough, but to the ordinary mind every dark snake is likely to be a labarria; and whether the nature of the fangs be rightly determined or not, the deadliness of the serpent would be regarded as evident even before inflammation and severe pain began.

In the case of the other common pit-viper, the rattlesnake, there is no such doubtfulness of identification, the rattle affording a certain means; and it is noteworthy that while one seldom or never hears here of a case of recovery from the bite of a rattlesnake unless some such certain method of treatment as amputation of the part has been resorted to, the reputed cases of recovery from the bite of the labarria are as common as the remedies employed are inefficacious for the purpose.

The species of rattlesnake (*Crotalus terrificus*) which is found in the Colony is commonly distributed over tropical and subtropical America, ranging from Texas and New Mexico to Northern Argentine. Specimens vary somewhat in tint and markings, at times being very dull-coloured and at others quite bright and striking. The brown ground-colour is usually marked on the neck by two black lines which pass into a series of dark rhombs with lighter centres along the back, the whole being outlined by a series of yellow or paler scales; and the scales are tuberculate and give a very rough aspect to the skin. Owing to the peculiar markings the skins are in great request for pouches, purses, belts, and other such objects—neckties even being at times prepared from them.

A peculiar feature in these and the other American vipers is the pit situated on each side of the face below and between the nostril and the eye, and which has secured for them the distinctive title of "pit-vipers," though its function is by no means evident.

The most characteristic feature of the species is, of course, the rattle, which, as is well known, is made up of a number of separable three-lobed pieces, closely packed together and interlocked by the incurving of the first lobe of each piece over the second lobe of the preceding, which allows the free movement of each, with the resulting shrill sound. Detailed reference to the structure and development of the peculiarities of this appendage is, however, unnecessary here, since in vol. v. new series, 1891, of 'Timehri' the matter has been already dealt with; but it may be as well to point out that the popular idea that a new ring is added each year, and

that therefore the number of rings give the age of the snake, is quite a mistaken one. Young rattlers are observed to exuviate on an average about every two months, and adults at times varying from three to five months under normally healthy conditions. Moreover the rings observed on a rattle vary entirely according to the number of pieces which have been broken away by damage from contact with sticks, stones, and other such objects. The older and more delicate pieces invariably get broken off, and those that remain represent only the harder and denser pieces which have been added during the most recent exuviations. The number present therefore is purely accidental.

As already mentioned, this is the commonest of the venomous snakes in the cleared or savannah lands. They will be found occasionally in cultivated fields, under or in the houses of the settlements, or along the paths, and are more frequently met with in open sandy and rocky ridges and wastes than in the actual swamps. Open lands with low scattered bushes are much more preferred than high forest, where they are seldom if ever met with.

The species is much less secluded in its habits than the generality of serpents, and will be more frequently observed in exposed places in the daytime than other forms, though the greater part of its activity is exercised at night, as is customary in the group. As a fact, much of the security of man as against snake-bite is due to the nocturnal habits of these creatures, owing to which they are not frequently brought in contact with man in the retired places which they seek out from daylight.

Little is known of the breeding-habits of these creatures. From actual cases which have been under observation, it seems likely that the number of young produced at one time is about from twenty to thirty—twenty-three, twenty-four, and twenty-two being the numbers in three cases.

The rattlesnake reaches a length of from 5 to 6 feet, and the adult females are peculiarly stout.

In many of its characters the bushmaster or Coonocooshi (*Lachesis mutus*) closely resembles the rattlesnake. The ground-tint, however, is reddish or maize-coloured, while the rhombs, which are elongated and irregular, are of a deep chocolate or purplish black. The tail is terminated by a conical spine replacing the rattle, and its under surface is covered with small scales instead of the ordinary posterior shields. The gape is marked by a black streak, and the shield above the eye (supraocular) is small and narrow compared with the width of the head.

This snake is certainly the giant among vipers, a specimen 14 feet in length having been taken in the Colony by Mr. John Junor. Specimens of from 8 to 12 feet are by no means uncommon, especially in the higher districts of the north-west, where they seem to be much more common than elsewhere. It is certainly the species that is most feared locally, being credited with the habit of attacking people whenever met with. This, however, is not the case, for in the writer's experience they have always remained as though asleep, and even on disturbance merely raised the head, darting out the tongue, as all these pit-vipers do, unless the disturbance be of a more or less violent kind. From the size to which it attains the bushmaster is, however, justly entitled to the dreadful reputation which it bears.

Under "Occasional Notes" in a former number of 'Timchri' an incident is narrated on the authority of Mr. Barnard, the well-known American mining expert in the Colony, of one of these snakes being observed to give out from its mouth, after being severely wounded, a number of small young specimens. Mr. Barnard asseverates that there was not, nor could there have been, any possible mistake of the anus for the mouth, the snake being directly observed in the water when it was struck. Since then another incident of the same kind has been observed by him, also in the Upper Mazaruni districts, and, there being no mistake, these incidents would seem to show that young vipers do at times take refuge in the mouth of their parent, however unlikely it may appear.

The labarria (*Lachesis atrox*) includes not only the commonly known form which passes under this name in the Colony, but also the fer-de-lance and the jararaca, which are evidently but varieties of one and the same widely distributed species.

Like the bushmaster, they possess a terminal horny spine and a black streak from the eye to the angle of the mouth; but the underside of the tail bears no small scales replacing the subcaudal shields, and the supraocular shield is large. The head, too, is much more sharply pointed, with distinct raised edges, the part anterior to the eye forming almost a neat triangle, and the scales are imbricated, being more elongate than tuberculate.

The colour of this species is very variable, ranging through grey, brown, reddish, and yellow, or a mixture of them. The rhombs are sometimes represented, but always faintly so—triangular spaces, outlined by paler or darker streaks, and with the apices above, being the most common—or the body may be simply spotted or slashed with lighter or darker tints. The underside may be uniform, or spotted, or blotched and

speckled. In very young specimens the end of the tail is yellowish white from birth and the general marking is much deeper and richer than in the adults.

Full-grown specimens reach a length of about 5 feet, the females being much stouter in proportion than the males. The number of young at a birth, from observed cases, appears to range from twenty to thirty, as in the rattlesnake; but the young labarrias are much smaller in proportion, corresponding to the markedly thinner build of the body in the two species.

As already mentioned, this is the commonly distributed forest- or bush-viper. Many harmless colubrine snakes and some of the boas, which possess some resemblance to it in markings, are frequently mistaken for it—mistakes that are very likely to be confirmed in the mind of the observer by the fact of the more or less severe pain and swelling which temporarily follow the bite of many of the colubrines with elongated and enlarged posterior teeth. One of these latter (*Helicops angulatus*) goes by the common name of water-labarria, and on this account bears an unjustly bad reputation.

The three vipers above described are strictly terrestrial forms, but the green labarria (*Lachesis bilineatus*) is an arboreal species with prehensile tail. The body is uniformly green or-spotted and speckled with black, and is marked on the outer scales with a yellow lateral line or series of spots. The end of the tail is red.

This species, which reaches a length of from 3 to 4 feet, does not appear to be common, or it well may be that it is not frequently observed owing to its green colour; and there are consequently but few cases of its being taken. Several green and harmless colubrines, and even the green boa, are generally mistaken for it, and they all appear to be designated "parrot"-snakes on account of their colour. The finely-scaled head with raised anterior edges, the loreal pit, the viperine fangs, and the other crotaline characters, however, will easily serve to distinguish it.

The remaining venomous species all belong to the genus *Elaps*, which is the American representative of that section of the Colubina to which the cobra and the greater number of the Eastern venomous serpents belong. In them the anterior maxillary teeth are perforated fangs which are permanently erect, the jaw not hinging on the skull as in the viperine snakes.

As already stated, only one of these species, the largest (*Elaps surinamensis*), is really to be dreaded; in the Colony it goes by the common name "Himeralli," and attains a

length of 6 feet. They are found along the waterside on the great rivers and along the sheltered creeks, and are thus not easily secured.

The species will readily be recognized by its red colour and by the black and yellow rings, the black being arranged in threes, with the central one very broad in comparison with the other two, each set of three separated from the others by a broad band of red, and each one ring of the set from the next by a band of yellow. The red scales of the head also are black-edged and give a very peculiar appearance to the species.

Two other common species (*Elaps corallinus* and *Elaps lemniscatus*) will readily be recognized by the arrangement of the black and red bands. In the latter the black rings are in sets of three separated from each other by narrow yellow or whitish spaces, and each set of three from the next set by red bands, which are usually wider than the others.

In *Elaps corallinus* the black and red bands are more or less regularly arranged, the black being edged with yellow, and the red spotted with black. These species reach a length of 3 to 4 feet, *E. lemniscatus* being at times longer and comparatively thick.

They are both found in moist grassy places, more especially by the trenches and creeks and in swampy lands. They pass usually under the common name of "coral"-snakes, and are frequently confounded with red and black banded harmless species, such, for instance, as *Erythrolamprus aesculapii*. In all the venomous species the eyes are very small and can hardly be distinguished, while in the others they are large and prominent; and this serves as a rough and ready means for the identification of the two groups.

Though capable of inflicting severe injury, if not death, on man, no case has ever come under the writer's notice in which such results have been experienced. Frequently these snakes will be seen being carried about by children and others who have not the faintest suspicion of the risk they run; and even when irritated it is generally a difficult matter to get them to open their mouths.

A fourth and rare small species (*Elaps psyches*) will at times be met with. It may well be called the pigmy coral-snake, since it seems never to exceed a length of about $1\frac{1}{2}$ feet. It will readily be recognized by the alternate black and reddish-brown rings, which are separated by narrow yellowish rings. The head, too, is black, and is marked on each side by a small yellow spot. From the rareness of its

occurrence this form may practically be disregarded in the enumeration of the venomous species.

It should be noted in connexion with these banded or coral-snakes that a very great deal of variation characterizes the greater number of species, and though they have been grouped under many different names, it can hardly be doubted that many of them will have eventually to be placed together. The four here mentioned are definitely well-marked forms.

LVII.—*Diagnoses of new Species of Land-Shells from the Islands of Flores, Sumbawa, and Sumba.* By EDGAR A. SMITH.

Ariophanta sumbawana.

Testa depresso globosa, anguste umbilicata, dilute olivaceo-fuscescens, zona indistincta pallida prope medium cincta, linea rufa ad periphoniam ornata; spira breviter conoidea, ad apicem obtusa; anfractus sex, superiores parum convexiusculi, lineis incrementi obliquis curvatis aliisque spiralibus minute græco-decussati, ultimus lævior, inflatus, subtus nitens, haud descendens; apertura obliqua, lato lunata, intus albido-cærulescens, linea rufa dimidiata; peristoma tenue, margine columellari albo, leviter incrassato, ad insertionem expanso, reflexo, umbilicum semi-obtegente.

Diam. maj. 43 millim., min. 34; alt. 27.

Hab. Sumbawa, 4000 feet.

Both the upper and lower surface of the body-whorl exhibit faint spiral striæ, which do not, however, produce fine granulation as on the upper whorls. Closely allied to *Nanina arguta*, Pfr., from Java, but more finely sculptured and more rounded at the periphery and banded.

Rhysota peramœna.

Testa depressa, inflata, anguste umbilicata, tenuis, pallide fusco-olivacea, apicem versus purpurco-rufescens, circa medium anfr. ultimi linea rufa cincta; spira convexa, brevis, obtusa; anfractus 5½, lineis incrementi obliquis arcuatis, striisque spiralibus confertis subgranose cancellati, superiores vix convexiusculi, sublente accrescentes, ultimus magnus, inflatus, convexus, haud descendens, circa umbilicum haud granulatus; apertura obliqua, latissimo lunata, intus sordide cærulescens, in medio uni-zonata; peristoma tenue, margine columellari prope insertionem reflexo et dilatato, dilute corneo.

Diam. maj. 41 millim., min. 33; alt. 26.

Hab. South Flores, at 3600 feet.

Only a single specimen obtained. Beneath the peripheral red line the colour for a short space is darker than the rest of the whorl, and just above it is a narrow and somewhat pale zone. The fine granular sculpture extends over the entire surface, with the exception of a small space around the umbilicus.

Xesta carinocincta.

Testa depressa, orbicularis, carinata, imperforata, tenuis, cornea, pellucida, polita; spira depressa, ad apicem obtusissima; anfr. 4, celeriter crescentes, convexiusculi, supra suturam concave impressi, superiores tres spiraliter minute punctato-striati, striis in anfr. ultimo sensim evanescentibus, ultimus ad peripheriam fortiter carinatus, supra et infra carinam concavus et rugis obliquis paucis hic illic instructus, antice haud descendens; apertura late oblique lunata, intus callo tenui nitente caeruleo induta; perist. tenuissimum, margine columellari ad insertionem leviter incrassato, reflexo, albo.

Diam. maj. 25 millim., min. 20; alt. 14.

Hab. S. Flores, at 3000 feet.

Distinguished by the flattish spire, carinate body-whorl, thin texture, the fine punctate striation upon the spire, &c., and allied to *X. Bocki* (Smith), originally described as a species of *Helicurion*.

Hemiplecta adolescens.

Testa imperforata, trochiformis, carinata, supra medium flavescens, infra pallida, ad carinam linea fusco-nigra cincta, ad apicem obtusa, nigrescens; anfractus $5\frac{1}{2}$, superiores tres convexi, sequentes minus convexi, oblique striati, ultimus ad peripheriam acute carinatus, haud descendens; sutura carina marginata; apertura angulato-lunata; peristoma tenue, simplex, margine columellari ad insertionem reflexo.

Diam. maj. $12\frac{1}{2}$ millim., min. 11; alt. 10.

Hab. Dongo Mountain, Sumbawa.

The generic position of this species is rather uncertain. All the four specimens have a somewhat immature aspect.

Chloritis (Trichochloritis) conjecta.

Testa depressa, suborbicularis, lato umbilicata, cornea, subpellucida, incrementi lineis tenuibus striata, undique conspicue punctata; spira depressa, ad apicem obtusa; anfractus 5, convexi, sutura subprofunda sejuncti, ultimus antice valde descendens, pone aperturam constrictus, circa umbilicum obtuse angulatus; apertura lunata, obliqua; peristoma albidum, vel pallide rufescens, tenue,

angusto expansum et reflexum, margine columellari ad insertionem dilatato; umbilicus plus minus infundibuliformis.
Diam. maj. 16 millim., min. 13; alt. 9.

Hab. Sumba.

This species might be regarded as a variety of *C. transversalis*, Mousson. It differs in being much more distantly punctate, in the smaller aperture, in the contraction of the last whorl behind the peristome, and the somewhat greater angularity of the edge of the umbilicus.

Planispira albodentata.

Testa depressa, subglobosa, angusto umbilicata, fusca, lineis incrementi obliquis arcuatis et granulis remotis in seriebus quincuncialibus dispositis instructa; spira brevis, convexa, obtusa; anfr. 4, convexiusculi, ultimus antice breviter descendens, pone labrum paulo constrictus; apertura valde obliqua, intus pallide roseo-purpurea; perist. expansum, et leviter reflexum, purpureo-lilaceum, in medio marginis dextri albo subtuberculatum, margine columellari pallido, dento albo intus instructo, late reflexo.
Diam. maj. 24 millim., min. 19; alt. 16.

Hab. South Flores, at 3600 feet.

The distant granules upon the surface, especially upon the body-whorl, the distinct columellar tooth, and the slight nodule upon the outer lip are the principal features of this species.

LVIII.—*Descriptions of some new Species of Scorpions.*
By R. I. POCKOCK.

Genus *OPISTHOPHTHALMUS*, C. Koch.

Opisthophthalmus ecristatus, sp. n.

♂.—Closely allied both to *O. Wahlbergi* and *O. opinatus*, with the vesicle granular and the ocular tubercle in the middle of the carapace.

Tarsi of third and fourth legs with a single row of 3 inferior spines in addition to those on the lobes; protarsus of first and second leg armed externally with 4 strong spines. Triangular area on carapace visible; interocular area granular in its anterior half, the smooth portion reduced to a patch on each side midway between the median eyes and the anterior border. Last abdominal sternite and lower side of first caudal segment with four strong smooth keels.

Tail short, barely three times the length of carapace; the third segment about as wide as long.

Hand not keeled, broad, completely covered above with fine close-set granules.

Mandibles with three stridulating-bristles on the inner surface of its basal segment.

Pectines with 25 teeth running right up to the base of the edge of the shaft.

Measurements in millimetres.—Total length 75; length of carapace 11, of tail 33.

Loc. Transvaal. Specimen procured from Mr. O. E. Janson.

Most nearly allied to *O. opinatus* as diagnosed by Kraepelin, but apparently differing in the granulation of the "Spiegel" of the carapace, the carination of the last abdominal sternite and of the first caudal segment below, structure of hand, spine-armature of posterior tarsi, &c.

Genus OPISTHACANTHUS, Pet.

Opisthacanthus fulvipes, sp. n.

Colour a tolerably uniform reddish brown, redder on the chelæ, the crests of which, as well as the fingers, are nearly black; legs and vesicle clear yellowish red.

Differs from the species common in the province of Natal, which I believe to be identical with *O. validus* of Thorell, in having the brachium and hands flatter and much less coarsely sculptured, the reticulation being finer and more evidently punctured; the superior prominence on the anterior surface of the brachium is also noticeably larger; the vesicle of the tail is distinctly higher and the granulation much coarser, its height being just about equal to the length of the carinate portion of the lower surface of the first segment and exceeding the width of the latter (in *validus* it is much less). The pectines are much longer as compared with their basal width than in *validus*. The tarsus of the fourth leg is armed below with 4 spines behind, 3 in front, one of the spines being upon the inferior distal angle (in the Natal form, *validus*, the lower side of the fourth tarsus is armed with 3 spines behind and 2 in front, with a bristle on the inferior distal angle).

In the spine-armature of its feet and the colour of its legs this species resembles the large Transvaal species which I described as *lævipes*, but which Kraepelin, wrongly I think, identified with *asper*, Pet.*. *O. fulvipes* may be recognized,

* I suspect my Nyasa species *rugiceps* is in reality the same as *asper*, Pet.

however, by having the external surface of the femora of the anal legs granular, only six or seven pectinal teeth, and the high vesicle.

Measurements in millimetres.—Total length 71; length of carapace 11, of tail 33; height of the vesicle 3·3; width of first caudal segment 2·5; length of hand-back 9, of movable digit 10; width of hand 7·8.

Loc. Basutoland (*R. C. Wroughton*).

Under *O. validus* I formerly (*Ann. & Mag. Nat. Hist.* (6) xii. p. 318) included more than one species. *O. asiaticus*, Keys., for example, which occurs at Port Elizabeth, is distinct from the Natal species which I now think is *validus*, Thorell; *O. capensis*, Thor., is also probably distinct, though unknown to me.

Genus CHELOCTONUS, Poc.

Cheloctonus anthracinus, sp. n.

Allied to *C. crassimanus*, Poc., but black all over, except the vesicle, which is ferruginous. The upperside of the brachium and hand much more coarsely sculptured, ornamented with thick smooth ridges and scarcely visibly punctured. In *crassimanus* the integument of the hand and brachium is densely punctured, the sculpturing forms a much closer and finer reticulation of ridges, and the inner portion of the upper surface of the hand is distinctly granular.

Measurements in millimetres.—Total length 54; length of carapace 7·2, of tail 26, of hand-back 5·5, of movable digit 7·2; width of hand 7.

Loc. Griqualand West (*J. ff. Darling*).

Genus HEMISCORPIUS, Pet.*

Hemiscorpius arabicus, sp. n.

Hemiscorpius lepturus, Pet., Pocock, *Journ. Linn. Soc., Zool.* xxv. (1896) p. 316 (not *lepturus*, Pet.).

Colour. Dull olive-yellow on the trunk; vesicle clear yellow; legs testaceous; chelæ reddish yellow; digits black, with pale tips.

Carapace longer than the first and second and than the

* *Mon. Ak. Wiss. Berlin*, April 1861, p. 426. Peters subsequently cited this genus as *Hemiscorpion* (*op. cit.* p. 511, May 1861). He described it originally, however, as *Hemiscorpius*, although in the editorial introduction to his paper, for which the editor and not Peters must be held responsible, it appears as *Hemiscorpion*. It is curious that Kraepelin, in his 'Revision,' does not cite the original reference to the genus nor Peters's admirable figure of the species.

fifth caudal segment, punctured, weakly granular in the hollows of the upper surface and at the sides; terga also punctured.

Tail about four times as long as the carapace; second segment a little longer than wide, fifth a little more than twice as long as wide; superior and supero-lateral keels strong and granular, the three inferior keels strong and granular on the third, fourth, and fifth, weakly granular on the first and second segments; the median keel obsolete on the anterior half of the first segment; vesicle wider than the fifth segment, smooth, punctured; aculeus long and normally spiniform in its distal half.

Chelæ punctured; humerus with normal granular keels above and in front; the upper and lower anterior crests on brachium granular; hand flat above, with weak median keel, strong but smooth external finger-keel; external keel of hand-back strong and granular; movable finger longer than carapace.

Genital operculum cordate, sulcate in front.

Pectinal teeth 10.

♂.—Not very different from female, but rougher, with close punctuation on the tergites and carapace; tail longer, the carapace a little shorter than its first and second segments; hand a little wider, its width about equal to the length of the hand-back; inner edge of the hand granular.

Genital operculum transversely oval, divided.

Pectinal teeth 13.

Measurements in millimetres.—♀. Total length 35; carapace 4·8, tail 18, movable digit 5.

♂. Total length 32; carapace 4·5, tail 19.

Loc. Aden (*E. H. Oates* and *Col. Yerbury*).

I formerly regarded the specimens here described as immature examples of *H. lepturus* known from Bagdad. No doubt, however, they are adult. The species may be recognized at once from *lepturus* by having the aculeus normally spiniform, and not short and subconical as described by Kiaepelin (JB. Hamb. xi. p. 111, 1894). The male of *lepturus*, moreover, has the vesicle peculiarly modified and elongate.

Genus URODACUS, Pet.

Urodacus macrurus, sp. n.

♂.—*Colour*. Carapace deep ferruginous, tergites darker; legs, chelæ, and tail paler yellowish red; fingers dark.

Carapace as long as the first and one quarter of the second

caudal segment, as long as the fourth; median excision deep; frontal lobes quadrate; interocular area smooth and polished; sides granular.

Terga closely granular; *sterna* smooth.

Tail very long, a little more than six times as long as the carapace; first segment almost or quite twice as long as wide, fifth nearly five times as long as wide; the superior keels of the first, second, and third segments gradually elevated behind and ending in a small spiniform tooth.

Vesicle large, its width equal to that of the third segment, its height equal to its width.

Chelæ: humerus granular above; brachium smooth above and behind, a few large scattered punctures behind; a row of 8-9 pores below; hand normally but not so strongly keeled as in *U. armatus*, Poc., and *U. novæ-hollandiæ**, quite smooth above externally and below; very weakly granular internally; about 12 pores along the underside of the keel.

Legs with femora weakly granular, patella smooth; pro-tarsi of first and second with 5 external spines.

Pectinal teeth 17-18.

Measurements in millimetres.—Total length 94; length of carapace 10, of tail 62, of its fifth segment 15.

Loc. Muldiva in North Queensland, ♂ (*Dr. Broom*).

Differs from all the known species of the genus in the great length of the tail in the male. The nearest to it in this respect is *U. hoplurus* †, Poc., from the East Murchison Gold Field, West Australia, in which the tail is about five times as long as the carapace. The two species also resemble each other in the large size of the vesicle; but in other characters they are very distinct. According to the table of the species of the genus that I published in the paper cited below, the species ranges itself under heading *b'* alongside of *U. novæ-hollandiæ*, but, apart from the great length of the tail, may be recognized by the posteriorly spiniform dorsal crests of this organ, the large vesicle, &c.

This species is further of great interest inasmuch as it is the first representative of the genus *Urodacus* that has been

* I learn from Prof. Kraepelin (*in litt.*) that the specimens from Perth in the British Museum which I formerly identified as *U. novæ-hollandiæ*, Pet., and which were, I believe, so named by Peters himself, are not specifically identical with the specimens in the Berlin Museum described under that name by this author. Probably *munivatus*, Thor., is their correct title, but, pending the publication of Prof. Kraepelin's latest conclusions on this point, I retain for them the term I have hitherto assigned to them.

† Ann. & Mag. Nat. Hist. (7) ii. p. 64 (1898). This paper contains diagnoses of all the species of the genus known to me at that time.

obtained in Queensland. Dr. Broom, who collected this scorpion himself, also procured a specimen of what is perhaps the female of the same species at Hill Grove, New South Wales.

Genus CHÆRILUS, Simon.

Chærilus agilis, sp. n.

♀.—*Colour* dark reddish brown, not distinctly variegated; vesicle, legs, and lower surface paler; hands ferruginous, with black keels and black digits.

Carapace with its anterior interocular area almost smooth, weakly granular in front; the rest granular, longer than the first and second and as long as the fifth caudal segment.

Terga closely granular, with a pair of posterior tubercles; the fourth with a pair of granular crests on each side.

Sterna smooth; third with a polished median posterior triangular area; fifth with a short series of granules on each side.

Tail about four times as long as carapace, slender; first segment a little wider than long, second a little longer than wide, fourth nearly twice as long as wide, fifth more than three times as long as wide: inferior keels of the first segment obsolete; of the second represented by a few granules; a little more granular on the third; the rest of the keels strong and coarsely granular; the median lateral represented by a few posterior granules on the second, third, and fourth, extending over two thirds of the lateral surface of the fifth segment; upper edges of the fifth rounded, granular, but not carinate, inferior crest of the segment posteriorly bifid; vesicle smooth, sparsely punctured, a long oval in shape, not flattened below, as wide as the second caudal segment; intercarinal spaces of tail smooth, except the superior, which are weakly granular.

Chelæ long and slender; humerus weakly granular above and below; the crests granular; the upper and lower crests bounding the anterior surface converging and fusing into a single crest in the distal half of the anterior surface: brachium longer than carapace, smooth, its posterior crests smooth; superior and inferior anterior crests granular, the latter uniting distally with a strong granular crest on the lower half of the anterior surface: hand long and narrow, the hand-back almost twice as long as the width of the hand and slightly longer than the carapace; in addition to the two keels which border the hand-back there are four strong keels, and two weak keels, one on the outer surface of the hand and the other on the inner surface; the hand-back keels granular

proximally, the keel along the inner edge of the upper surface coarsely granular throughout, the rest of the keels mostly smooth, though more or less granular proximally; intercarinal spaces also almost smooth; fingers long and slender, the movable considerably exceeding the hand-back and more than twice the width of the hand, furnished with 8 rows of teeth, and on the inner side of these some scattered larger teeth.

Legs almost smooth externally; femora weakly granular, very long, patella of fourth as long as carapace.

† Pectinal teeth 4.

Measurements in millimetres.—Total length 56; length of carapace 7·5, tail 30, hand-back 8, movable digit 9·2; width of hand 4·2.

Loc. The Caves, Selangor in Malacca (*H. N. Ridley*).

Easily recognizable by its long and slender chelæ and legs. It is the only species of the genus known to me in which the patella of the fourth leg is as long as the carapace.

Chærilus lævimanus, sp. n.

Colour a tolerably uniform reddish black, not noticeably variegated; hands paler than trunk; variegation of legs indistinct, but more obvious than on the trunk.

Trunk moderately coarsely granular, interocular area coarsely granular in front, more finely so behind; *tubercle* more spherical than is usually the case, its anterior portion not prolonged: *terga* with lateral granular crests; lateral crests scarcely traceable on the fifth.

Sterna entirely smooth.

Tail nearly four times as long as the carapace, which slightly exceeds the length of its first and second segments; upper surface of segments almost smooth; the superior and supero-lateral crests weakly granular: lower surface of first segment finely shagreened, not crested; of second also finely shagreened, with scarcely traceable keels; of third with keels still quite feeble, but weakly granular; of fourth with granular keels; lateral surface of segments finely granular, the inferior lateral crests distinct and weakly granular on all the segments except the first: *vesicle* smooth, not globular, elongate, its width a little excelling its height and equalling width of fourth segment.

Chelæ: humerus granular above and in front, its superior and anterior keels also granular, smooth elsewhere; brachium almost entirely smooth, its upper crest with only a few granules, also a few on the lower edge of the anterior surface;

hand of medium width, its width less than length of hand-back and of movable digit, furnished with only *five* crests, the middle of the three crests which normally run from the immovable digit, as well as the median crest on the outer half of the upper surface of the hand, obsolete; the two internal (anterior) crests of the upper surface very weakly granular, the external crest of the upper surface quite smooth; the inner surface of the hand with a few granules near the base of the fingers; for the rest the spaces between the keels are quite smooth; movable digit longer than the hand-back and just about equal to the length of the carapace, with about eight rows of teeth.

Pectinal teeth 4.

Measurements in millimetres.—Total length 41; length of carapace 6, of tail 22; width of hand 4.2; length of hand-back 5, of movable digit 6.

Loc. Pulo Gaya, British North Borneo (*S. S. Flower*).

Most nearly related apparently to *C. celebensis*, Pocock (Max Weber's Zool. Ergebnisse etc. ii. p. 93, 1893), from Celebes; but certainly differing in the following particulars:—In *celebensis* the ocular tubercle is prolonged anteriorly; the upperside of the tail between the crests is granular; the normal keels on the hand are more strongly pronounced and more granular; the base of the immovable digit and the adjacent area of the hand is strongly granular.

Chærilus rectimanus, sp. n.

♀.—In size and colour much resembling *C. celebensis*, but easily recognizable by the form of the hand. In *celebensis* the hand is shorter, the inner edge is distinctly granular and convexly rounded, and the median keel on the upper surface is obsolete, while the remaining two keels are strong, the area between them being nearly flat; the movable digit is about as long as the hand-back. In *rectimanus*, on the contrary, the hand is longer, its inner edge is very weakly granular, straight, and parallel with the outer edge; the median crest on the upper surface is as strong as the others, although all are weak; the movable digit is shorter than the length of the hand-back, which far exceeds the width of the hand. The caudal crests in *rectimanus* are also stronger and more strongly granular than in *celebensis*.

♂.—With much longer chelæ than the female; width of the hand about half the length of the hand-back, length of hand-back exceeding that of carapace; brachium also longer than carapace. In the female the brachium is shorter than the carapace.

Measurements in millimetres.—♀. Total length 24; length of carapace 3.2, of tail 12; length of brachium 3, of hand-back 3.5, of movable digit 3; width of hand 2.2.

♂. Total length 20; length of carapace 3.2, of tail 11.5; length of brachium 3.5, of hand-back 3.5, of movable digit 3; width of hand 2.

Loc. Singapore (*H. N. Ridley*).

Chærilus variegatus, Simon, subsp. *nigricolor*, nov.

At once recognizable from the typical *variegatus* by having the dorsal surface, tail, legs, and palpi of a uniform dull black, the sterna and coxal areas dull brown and not mottled and variegated with yellow. The granulation of the dorsal surface and tail is also less close, and the lower surface of the first and second and often of the third caudal segments is smooth, the keels being obsolete, at least on the first and second. In *variegatus* the second and third segments are granular and granularly carinate below.

Measurements in millimetres.—♀. Total length 45; length of carapace 5.8, of tail 21.5, of hand-back 4.2, of movable digit 5.5; width of hand 5.

♂. Total length 43; length of carapace 5.6, of tail 24, of hand-back 5.5, of movable digit 5.5; width of hand 6.5.

Loc. Protjat in Eastern Java (*type*) and Kogok in Western Java.

Several specimens of both sexes presented to the British Museum by Prof. W. Kulczynski. We have representatives of the typical form from Tjibodas, Buitenzorg, and the Gede Volcano.

Genus PARABUTHUS, Poc.

Parabuthus flavidus, sp. n.

Allied to *P. capensis*, Hempr. & Ehrenb. (= *planicauda*, Poc.), but differing in having the ocular tubercle larger, and the tail thinner and lower, with the four inferior keels on the second and third segments much more strongly elevated posteriorly, the upper surface of the first mesially and normally longitudinally excavated, and the lateral and inferior intercarinal spaces of the tail sparsely and weakly granular; in *planicauda* the sides and lower surface of the tail are closely and coarsely granular, and the upper surface of the first is not excavated. It also differs from *raudus* of Simon at least in having the inferior keels of the first caudal segment granular.

Measurements in millimetres.—Total length 48; length of carapace 5, of tail 27.

Loc. Tangs, in Bechuanaland.

A single female sent to the British Museum by Mr. H. A. Spencer.

BIBLIOGRAPHICAL NOTICE.

The Resources of the Sea ; as shown in Scientific Experiments to test the effects of Trawling and of the closure of certain Areas off the Scottish Shores. By W. C. M'INTOSH, M.D., LL.D., F.R.S., &c., Professor of Natural History in the University of St. Andrews, Director of the Museum and of the Gatty Marine Laboratory. 8vo, London, 1899. Pp. xvi, 248. Frontispiece, 16 plates, and 8 woodcuts; with Appendix of 32 Statistical Tables.

IN this volume Professor M'Intosh has accomplished a laborious but certainly invidious task. Critically examining a complicated mass of statistics published by the Fishery Board for Scotland in their Annual Reports, mainly pertaining to the influence of beam-trawling, he descants on the material in a broad light. The subject at issue resolves itself into somewhat as follows:—Has the twelve-years abolition of trawling in extensive fishing-grounds in Scotland been as productive of benefit to the fisheries as was anticipated when the bye-law was enforced, April 1886? If not, wherefore continue it? To the first query Prof. M'Intosh gives a distinctly negative reply. To the second, in substance, he strenuously submits that abolition of the restriction to trawling may safely be adopted.

The Fishery Board officially recognizes * that closure of the Firth of Forth, St. Andrews Bay, and Aberdeen Bay have proved failures in so far as respects increase of fishes in those areas. Notwithstanding, there has been no relaxation of their bye-laws affecting the said inshore waters, though this course might be deemed in consonance with their own conclusions. Furthermore, they shift the basis of their previous argument of the trawlers' destruction of brood inshore to action on presumed but hitherto imperfectly known spawning-grounds offshore in the Moray Firth (and Firth of Clyde). These more recent investigations comprise several areas beyond the three-mile limit, *e. g.* Smith Bank &c.

Meantime a considerable section of the fishing community and those commercially interested naturally feel aggrieved †, and it appears as if trawlers and liners are equally dissatisfied with the

* See 14th Ann. Rep. of the Fishery Board for Scotland for 1895 (1896): Conclusions, p. 12.

† Witness the discussion and resolution *re* "Fishing in the Moray Firth," Proceedings National Sea-Fisheries Protection Association, Conference 1898.

Board's decision. Especially is this the case where foreign craft can come and trawl without let or hindrance—nay, dispose of their catch in the British ports, while the native population, by law, are only allowed to look on despairingly.

Possibly the members of the Board may have been considerably influenced by papers of their able scientific superintendent Dr. T. Wemyss Fulton. In one * the ten years (1886–1895) experiments are admirably summarized. From his point of view of the statistical analysis a diminution, not increase, of the important flat-fishes has occurred, which he suggests “may probably be traced to the influence of beam-trawling in the open waters where the fishes spawn.” As to the round fishes he expresses doubts.

Thus stands the question—one as interesting and instructive to the biologist, as all-important alike to the fisherman, the merchant, and the public generally.

In Prof. McIntosh's Preface the following remark sets us wondering. He says: “It was hoped that opportunities would have been afforded for repeating in 1898, on the same dates and, as far as possible, under the circumstances, the experiments of 1884; but the authorities did not appear to see either the way or the importance of such an enterprise.” We may express regret that this crucial test was not applied.

The author's opening chapter is framed in the wide aspect of science. His keynote may be said to be the cycle of interdependence between the lowly plant and animal life in the sea and its fish fauna. Add to this the surcharge of marine food, the enormous fecundity of most food-fishes, their pelagic eggs scattered broadcast, together with boundless regions unfished, which nevertheless supply by replacement voids in the neighbouring areas where depletion may have occurred. These and other reasons conduce to his belief that the predicated utter ruin of our sea-fisheries is not yet.

He contrasts man's destructive influence among certain groups of animals on the land, in the air, and in the water. Nor does he mince the fact that the once hordes of Ungulata &c., even families of birds, are a fast diminishing quantity by human agency, though he points out that some sections of Mammals and Aves hold their own, whilst many Insecta defy extirpation. Concerning freshwater fishes, a sure decrease results by over-fishing unless artificial measures are resorted to.

Except among seals, whales, and Sirenia, he holds that oceanic life does not present the same chance of speedy extermination. He brings forward the plenitude of the Plankton aliment, as regular as the tides and as powerless to be arrested. As the Diatoms nourish Foraminifera and Radiolarians, so they in turn are the prey of

* “Review of the Trawling Experiments of the ‘Garland’ in the Firth of Forth and St. Andrews Bay in the years 1886–95,” 14th Ann. Rep. Fish. Board Scotland, pp. 128–149, pls. i., ii. Consult also his papers, “The Distribution of Immature Sea-Fish, and their Capture by various Modes of Fishing,” 8th Ann. Rep. F. B. S. for 1889, and “On Over-Fishing of the Sea and the Culture of Sea-Fish,” 10th Rep. for 1891. -

higher forms. Cilio-flagellates, Porifera, and Hydrozoa &c. literally are exhaustless. Annelids and the groups of the minute Crustaceans (Copepods &c.) so teem as to be far beyond the interference of man. These, be it observed, are the standard food of the great body of the inshore commercial fishes.

Of the slow-growing lobsters and edible crabs, however, signs of diminution are not wanting. This applies to sedentary oysters and some of the marketable mollusks; hence beneficially they have received culture and legislative protection. But others of the Mollusca, *e. g.* the free-swimming Cephalopods and Pteropods, or in contrast many sunken Lamellibranchs (say *Macra* and *Scrobicularia*), continue to fruitfully multiply in spite of wholesale destruction, the former classes forming the nutriment of the great roaming whales, the latter bivalves supplying the food of the ground-loving plaice, dab, and flounder.

In another chapter the effects of trawling and of lining are discussed with respect to the surrounding Invertebrate fauna, to adult and young fishes, and to the eggs. Likewise the results of the changes in fishing-vessels and their gear and the conditions of the East Coast fishers and fisheries generally. The substance of this chapter has already appeared in the 12th Ann. Rep. F. B. S. for 1893 under "Remarks on Trawling"*; but it has been remodelled, amended, added to, and, in fact, brought up to date. Indeed, what has taken place in the statistical returns given between 1894 and 1897 inclusive constitutes an important section of it.

Passing on, Prof. McIntosh devotes Chapters III.-VI. to a close criticism of the investigations on trawling experiments of the Board's steamer 'Garland' during 1886-1895, those in St. Andrews Bay, the Firth of Forth, the Moray Firth, and the Firth of Clyde being taken in sequence. There follows in Chapter VII. his summary and conclusions of the entire questions at issue.

Lastly there is an Appendix of thirty-two tables of statistics, which we consider he has done wisely in thus separating from the body of the text. In the latter, however, there are a few scattered tabular data, rendering some points easier to be grasped by the general reader. The work is further illustrated by sixteen plates and eight woodcuts. Though some of these may seem rather a side issue, others are graphic expositions of ways and means prevalent among the Scotch east coast fishers and fisheries. Altogether they materially help to lighten the volume, wherein necessarily facts, opinions, and arguments bristle throughout.

The Scotch fisherfolks are well known to be an industrious, thrifty, hard-working, and upright community; but, judging from the author's types, to an English eye they are no beauties.

We may remark that there is a decided want of a chart or sketch-diagrams to represent the relative positions of the forty-three

* See also the author's pamphlet, 'A Brief Sketch of the Scottish Fisheries, chiefly in their Scientific Aspects, during the decade 1882-1892.' 8vo, Dundee, 1892.

observing stations, as it is puzzling to follow the recital of the data thereon. We had to refer constantly to those contained in the 5th, 6th, 9th, and 14th Ann. Rep. F. B. S.

Subsidiary short headings defining the year's operations would likewise have been advantageous to the reader. It is curious to observe that the Professor throughout sticks to the original Scottish "Frith" (so pronounced north), whereas "Firth" is the recognized orthography among geographers, the Admiralty charts, &c.

Whatever the issue of this fisheries controversy, the writer of the volume has given cogent reasons for his views. Something may be said on both sides. It has to be noted that the Board has without intermission for a dozen years dunned the government for a trustworthy sea-going steamer. To their credit also they have carried out quite a variety of valuable scientific researches—to wit, on sea-fish, crustaceans and shell-fish, their food, breeding, hatching, bait, North-Sea currents and fishing-grounds, besides physical observations, &c., wherein Prof. M'Intosh and his pupils have contributed a fair quota. On the other hand, their critic has been indebted for their hundreds of pages of statistics for much of his data. Their patent mistakes have been in jumping hastily at seeming conclusions based on the superabundant year 1887; in ignoring the well-known natural fluctuations of seasons' fishings and weather influences; again, in not placing due weight on night-fishing and irregularity of experiments during hot and cold months, thus being led astray in contrasting the five yearly periods. Hence Prof. M'Intosh quite reasonably views the matter in a different light, and the every-day experience of fishermen in a commercial sense lends him support. The Board's case is undermined by their own admission that the areas of closure have not improved and that shore-spawning is not the habit of the bulk of marketable fishes.

Moreover, in papers already referred to, Dr. Fulton himself says:—"Simple prohibition merely of the landing or sale of the [immature] fish may do more harm than good; regulation to be effective should be exercised at the fishing-grounds or in connexion with the fishing; and when the difficulty of carrying out simple police regulations is remembered, *it is clear that this obstacle will be very great.*" [Precisely so! The italics are ours.] "In declining fisheries the more protection of immature individuals has not been effective; it has been found necessary to supplement restriction by artificial cultivation." All this, and other statements, appears to us amply to justify Prof. M'Intosh's contentions.

Here also comes in the 3- and the 13-mile limit, awkward and conflicting in several ways. As Mr. George Alward (of Grimsby) observed at the Conference of the Nat. Sea-Fish. Assoc., 1898:—"I say it will be a sorry day when the people of England attempt to extend territorial limits. There can be only one result, and that would be that a line would be drawn down the centre of the North Sea, and the nations on either side would claim their part." Our share would not be the best of the bargain. Nor would it abate friction one jot, but rather give rise to international jealousies and

troubles, worse than the present condition of things, and this without increasing the fish or alleviating the liner and trawlers' grievances. Surely, then, Prof. M'Intosh's "fast cruisers and search-lights" are not altogether a phantom of his imagination.

The practical outcome of the extraordinary changes in vessels, gear, &c. alone means intense competition. If our sea-fishermen are hampered neither they nor the nation will benefit. However plausible theoretical measures as a panacea may appear to be, they cannot control human nature nor "the resources of the sea." Unfortunately a large majority of individuals are unable to follow the intricacies of a highly complex problem, hinged on natural causes with many unforeseen contingencies; yet the public demand a categorical answer in reply, and judge alone by immediate results: nor can their notions be prudently thrust aside. From the biologist's point of view it is to be hoped that the Board will rescind their bye-law, while they continue to pursue the collateral researches incident to the debated question.

We have no desire whatever to be one-sided in this controversy, but the verdict of the scientist is at stake. Whether the Scotch Fishery Board's experiments have been faultlessly carried out or otherwise, to the public generally they have not in these trial-instances served to prove that the biologist's views and tests are infallible. The graceful, indeed ordinary, mode of procedure would be to consent to alter the present vexatious restrictions, while, as already hinted, further scientific researches proceed apace. Much stress is laid on the extirpation or diminution of larger animals by man's agency; but palæontology emphasizes the fact that without his influence throughout ages the natural law has been change or disappearance of whole tribes of animals, the biggest going first. The law of supply and demand goes on unceasingly in commercial matters, and this country supports free trade versus protection. Our markets are already flooded with continental products, and are we to fetter the energies of our fishers and capitalists?

Fishermen are free men in every sense, and, though wedded to old methods, are keenly alive, nay forced, to progress through the rapid changes marking the last half-century. He will be a Solomon indeed who can adjudicate and pacify groups of fishermen. Why every fishery-station thinks its methods better than those of its neighbours. No two of the English Sea-Fisheries Committees legislate and act practically alike, and, as a climax, Scotland, with her abolition of trawling within the 3-mile limit, has powers not vouchsafed England.

John Stuart Mill truly says: "In every department of common affairs Practice long precedes Science; systematic enquiry into the modes of action of the powers of nature is the tardy product of a long course of efforts to use those powers for practical ends." Biologists themselves must be agreed and their proofs undeniable before they insist on forced measures. Prof. M'Intosh's '*Resources of the Sea*' therefore comes opportunely, and much of his evidence of the balance of nature and the constant recuperation of overfished

areas seems, from our own knowledge, to hold good. Whether sea-fish hatching will prove successful in the future time will show, but the Dunbar Hatchery has not altogether been prosperous. Let us hope the new hatchery at Nigg Bay, Aberdeen, will flourish, with best wishes to its active promoter and superintendent.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

February 22nd, 1899.—W. Whitaker, B.A., F.R.S.,
President, in the Chair.

The following communication was read:—

‘Remarks on the Genera *Ectomaria*, Koken, and *Hormotoma*, Salter; with Descriptions of the British Species.’ By Miss Jane Donald.

This paper deals with some of the genera into which the family of the Murchisoniidae has been divided, and confines itself to the established genus *Hormotoma*, Salter, and the new genus *Ectomaria*, Koken, which contain some of the oldest known species of elongated gasteropoda. Both forms are distinguished from the typical *Murchisonia* by merely possessing a sinus in the outer lip, instead of having a deep narrow slit with parallel edges; the lines of growth also retreat towards, and advance from, the sinus more obliquely. The Author prefers to separate the elongated shells from the shorter Pleurotomariidae, as Koken does, and to let the former constitute the family Murchisoniidae.

The genera are described, with two new species of *Ectomaria* and two new varieties of *Ectomaria pagoda*, Salt. Six new species of *Hormotoma* are also described, together with the species *H. Salteri*, Ulrich & Scofield, *H. gracillima*, Salt., *H. cingulata*, His., and *H. articulata*, Sow. The species of *Ectomaria* are all derived from the Cambrian and Ordovician rocks of Scotland, and the species of *Hormotoma* from various beds, ranging from the Durness Limestone to the Upper Ludlow rocks. An account of the distribution of the genera over Europe and America is also given.

March 8th, 1899.—W. Whitaker, B.A., F.R.S.,
President, in the Chair.

The following communication was read:—

‘An Analysis of the Genus *Micraster*, as determined by rigid Zonal Collecting, from the Zone of *Rhynchonella Cuvieri* to that of *Micraster cor-anguinum*.’ By Dr. A. W. Rowe, F.G.S.

The Author has endeavoured to show, by means of rigid zonal collecting on a large scale, from the White Chalk of the Southern and

South-eastern coast-sections of England, that the genus *Micraster* is one and the same form gradually evolving from the more simple to the more complex. In doing this, he also contends that the genus may be divided into definite groups, each or several of which are absolutely diagnostic of the various Chalk zones, as defined by Barrois. The conclusions arrived at point to the regular and continuous deposition of the White Chalk, and strikingly confirm the general accuracy of Barrois's zoning.

The paper gives a minute comparison and description of the genus *Micraster* from a general point of view, and from that of a group, and deals particularly with the essential details of the test of the especial groups characteristic of each zone. The Author claims that, so far as *Micraster* is concerned, each zone is marked by a definite facies of essential characters of the test, which are purely horizontal, and that all species and varieties, however divergent they may apparently be, occurring at any given horizon, are stamped with the impress of these marked horizontal features.

The Author proves that, while in an isolated instance, one may be unable to decide the horizon in the White Chalk whence a specimen of *Micraster* was derived, in the ninety-nine other cases the diagnostic features described by him point unerringly to the exact horizon, and thus afford a valuable aid to stratigraphical geology, especially as the essential zonal features of the test are easily made out in the field.

The Author discusses the four groups into which the species of *Micraster* in these zones may be placed, and describes in detail the species in these groups.

The paper is illustrated by photographs, micro-photographs, and lantern-slides.

April 12th, 1899.—W. Whitaker, B.A., F.R.S.,
President, in the Chair.

The following communications were read:—

1. 'Fossils in the University Museum, Oxford: I. Silurian Echinoidea and Ophiuroidea.' By Prof. W. J. Sollas, M.A., LL.D., D.Sc., F.R.S.

Attention is called to the correlation of structure and function in the locomotive organs of Asteroidea, Ophiuroidea, and Echinoidea. In the case of the two latter, movement depends on tension directed along the tube-feet. In starfishes this tension is met by the disposition of the ambulacral ossicles in the form of an arch: in urchins by a continuous tessellation of the surface, which would only be weakened by arch-like interruptions. If, however, urchins have been evolved from an Asteroidea stem, they may have originally possessed arch-like ambulacral grooves, and the present plates of the ambulacra may have been subsequently acquired. In *Palæodiscus ferox* of the Lower Ludlow, Leintwardine, which by the structure of the buccal armature is definitely shown to

have been an Echinid, the ambulacra possess just such characters as theory anticipates: an inner arch of poriferous ambulacral plates, homologous with those of a starfish, is closed externally by a series of paired plates, which represent the ambulacral series of an urchin.

The undoubted Asteroid affinities of the urchin lead to an attempt to find homologies for the elements of 'Aristotle's Lantern': the pyramids are regarded as equivalent to the first pair of ambulacral plates, the epiphyses to the corresponding pair of ambulacral plates of the Echinoid series, and the teeth are compared to the Asteroid odontophore, which has acquired a persistent root.

A new genus assigned to the Echinida is characterized by the excessively numerous minute plates which form the interambulacra. Reference is made to *Echinocystis pomum*, Wv. Thomson; and to a species of *Protocidaris*, Whidborne, from Lower Ludlow beds, which seems to be identical with the type-species found in Devonian rocks.

The results are given of a re-examination of the unique specimen on which Dr. H. Woodward founded the genus *Eucladia*. The Author agrees with Dr. Woodward in regarding the exposed surface of this fossil as ventral; it bears the buccal armature and madreporite, and gives origin to the arms. On slicing two of the arms, no plates were exposed which it was possible to certainly identify with vertebral ossicles. Some hollow casts, from the Lower Ludlow of Leintwardine, which have hitherto been regarded as too problematical for determination, are shown to represent an organism closely allied to *Eucladia*, and are provisionally referred to that genus. The number of arms in this new species is less than in the original (*E. Johnsoni*), and they are more nearly equal in size. A new genus, closely allied to *Eucladia*, is founded on a small, well-preserved specimen from the Wenlock Limestone of Croft Farm. In this the pairs of arms of each paired series are only two in number, while in the new species of *Eucladia* at least four, and in *E. Johnsoni* as many as seven are present. *Eucladia* and the new genus are regarded as aberrant Ophiurids, and are placed in a new order as a group of the same value as the Euryalae. They are defined as Ophiurida possessing paired series of arms, covered externally by imbricating plates, but devoid of ambulacral ossicles. The buccal armature is abnormal.

2. 'Note on the Occurrence of Sponge-spicules in the Carboniferous Limestone of Derbyshire.' By Prof. W. J. Sollas, M.A., LL.D., D.Sc., F.R.S.

Remains of sponge-spicules are fairly abundant in a rock-slice taken from a specimen obtained by Mr. H. H. Arnold-Bemrose from Tissington cutting. They present themselves as sections through long cylindrical rods, but the terminations are obscure and indefinite, and the form cannot be referred with certainty to any recognized order of Sponges. The spicules were doubtless originally siliceous,

but they are now completely transformed into carbonate of lime. Rhombohedra of calcite appear to have completed their growth as readily within the spicule as outside it, and the final result of the corrosion is to entirely replace the opal of the spicule by a congeries of minute crystals of calcite. As the crystals may have begun their growth outside the spicule, the latter rarely preserves its characteristic regular outlines. The crystals being frequently bounded by impurities of the limestone, the spicules are often as clearly defined as corresponding structures in the Chalk.

MISCELLANEOUS.

A Note on the Date of the Parts of 'Humboldt and Bonpland's Voyage: Observations de Zoologie.'

THIS book was issued in livraisons as follows:—

Vol. I., livr. 1,	pp. 1-46 (& 47, 48),	1805,	forming pp. 1-25 of 2nd issue.
2,	-104,	1807,	26-64 "
3,	-196,	1807,	65-126 "
4,	-293,	1809,	127-200 & 253-259 of 2nd issue.
5 & 6,	-412,	1809,	261-297 & 201-252 & 298-309 of 2nd issue.

A break then occurred until 1812, when livraison 7 was issued, with the following "Avis" on a loose slip of paper:—"Avec cette Livraison, qui terminera le premier volume des Observations de Zoologie et d'Anatomie comparée, on fournit aux Abonnés un nouveau texte pour la totalité de ce volume. On a cru devoir faire ce sacrifice, afin que cet ouvrage ressemblât, pour le caractère et le papier, à toutes les autres parties du Voyage de M. de Humboldt. Les Acquéreurs pourront faire relier ce volume; ils rendront tout le texte des livraisons précédentes, dont il ne conserveront que les planches." Fortunately for nomenclature the British Museum (Natural History) secured some years ago a parcel of odd parts, which prove to be a complete set of the first issue; these are properly cared for, and are of considerable interest.

The completion of the work dates as follows:—

Livr. 7, pp. 305-368 (with reprint of pp. 1-412 of 1st issue, forming pp. 1-309 of 2nd issue), 1812 (T.P. dated 1811).			
Vol. II., livr. 8,	1-64,	1813.	
9,	-96,	1813.	
10,	-144,	1817.	
11, }	-224,	1821.	
12, }	-224,	1821.	
13,	-256,	1827.	
14,	-352,	1832 (T.P. dated 1833).	

C. DAVIES SEEBORN
(*'Index animalium'*).

THE ANNALS

MAGAZINE OF NATURAL HISTORY.

AND

[SEVENTH SERIES.]

No. 18. JUNE 1899.

LIX.—*On some new or little-known Goniatites from the Carboniferous Limestone of Ireland.* By G. C. CRICK, F.G.S., of the British Museum (Natural History).

MOST of the specimens described in the present paper are in the collection of Dr. A. H. Foord, F.G.S., of Dublin, who has already devoted much attention to the Cephalopoda from the Carboniferous Limestone of Ireland; a few are in the British Museum collection; some belong to the Geological Survey of Ireland, and a few to the Museum of Science and Art, Dublin. To Dr. Foord, to the authorities of the Geological Survey of Ireland and of the Museum of Science and Art, Dublin, I am greatly indebted for the loan of the specimens in their respective collections.

During a visit to the Museum of the Geological Survey of Ireland I was fortunate enough to identify the type specimens of de Koninck's *Goniatites* [= *Pericyclus*] *plicatilis* and *G.* [*Brancoceras*] *ornatissimus*. In order to facilitate comparison, I have redescribed them in the same manner as the other species which are described in the present paper.

The plan adopted for the descriptions of the species is that given in the Introduction (pp. xviii and xix) to part iii. of the 'Catalogue of Fossil Cephalopoda in the British Museum

(Natural History), with only a few alterations. The term "umbilical zone" * has been substituted for the somewhat ambiguous expression "inner area of whorl"; and since in some species this zone slopes towards the centre of the umbilicus, I have thought it advisable in the measurements of these species to give the width of the umbilicus both at its margin and at the suture of the shell. The term "peristome" is used for the margin of the aperture, and in describing the aperture Prof. Hyatt's terms have been adopted—"crest" for projecting parts and "sinus" for inflections of the outline; also the same author's term "hyponomic sinus" for the ventral sinus of the aperture and of the lines of growth, it being due to the hyponome or motor organ, usually called the "fleshy funnel" in the recent *Nautilus* *.

Excepting figs. 6 and 15 and the drawings of the suture-lines, I have to thank Dr. Foord for the original drawings of the illustrations accompanying this paper.

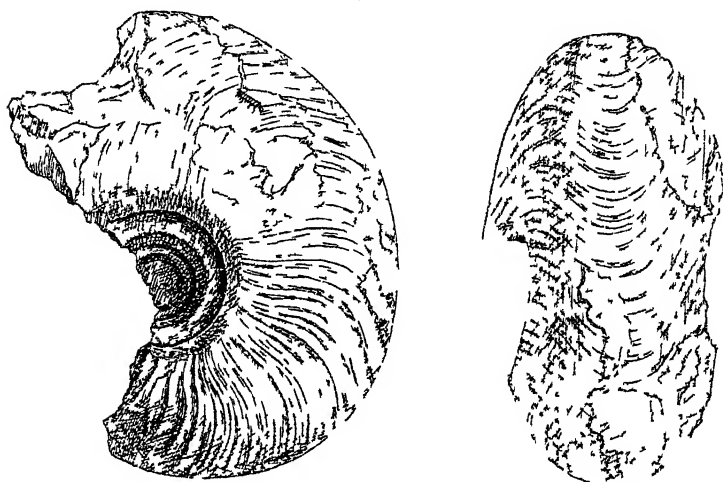
Pericyclus Foordi, sp. n. (Fig. 1.)

Sp. char. Shell discoidal, somewhat compressed and rather widely umbilicated; greatest thickness at the margin of the umbilicus, rather more than two fifths of the diameter of the shell; height of outer whorl a little more than three sevenths of the diameter of the shell. Whorls eight or nine; inclusion fully three fourths; umbilicus rather deep, displaying the umbilical margins of all the inner whorls, about three tenths of the diameter of the shell in width. Whorl semielliptical in cross-section, a little higher than wide; indented to about two fifths of its height by the preceding whorl; periphery convex, imperfectly defined; sides feebly convex; umbilical zone well-defined, sloping towards the umbilicus, and making an obtuse angle with the sides, rather narrow. Body-chamber not fully seen, but occupying at least one half of the outer whorl; aperture not seen, but the peristome probably (judging by the ornaments and the lines of growth) with a feeble lateral crest at about the middle of the lateral area and a deep and wide hyponomic sinus. Depth of chambers not seen; suture-line only imperfectly known. Test ornamented with fine, backwardly directed, and somewhat irregularly spaced riblets, which form a rather low crest at about the

* See A. Hyatt, "Phylogeny of an acquired Characteristic," *Proc. Amer. Philos. Soc.* vol. xxxii. no. 143, pp. 422 *et seqq.*; and "Carboniferous Cephalopods," 4th Ann. Rep. Geol. Surv. Texas for 1892, pp. 380 *et seqq.* (1893).

middle of the lateral area and a deep and wide hyponomic sinus on the periphery, where some of them are thicker than the rest and somewhat regularly placed. Up to a diameter

Fig. 1.



Periclytus Foordi.—*a*, lateral view : *b*, peripheral view of the same Carboniferous Limestone St Doulagh's, Co. Dublin, Ireland. Drawn from an example in the collection of Dr A H Foord, FGS. About three fifths natural size

of about 56.0 millim. the test is ornamented with rather coarse regularly placed ribs, which are separated by interspaces a little wider than themselves and have the same direction as the ornaments of the adult.

Dimensions.

	(i.)	(ii.)
Diameter of shell	106.5 mm (100.0)	49.0 mm. (100.0)
Width of umbilicus (at suture of shell)	32 " (30.0)	"
Width of umbilicus (at its margin)	42 " (39.4)	25.0 mm. (51.0)
Height of outer whorl	47 " (41.1)	
Ditto above preceding whorl .	28 " (26.2)	
Thickness of shell	46 " (43.1)	33.0 " (67.3)

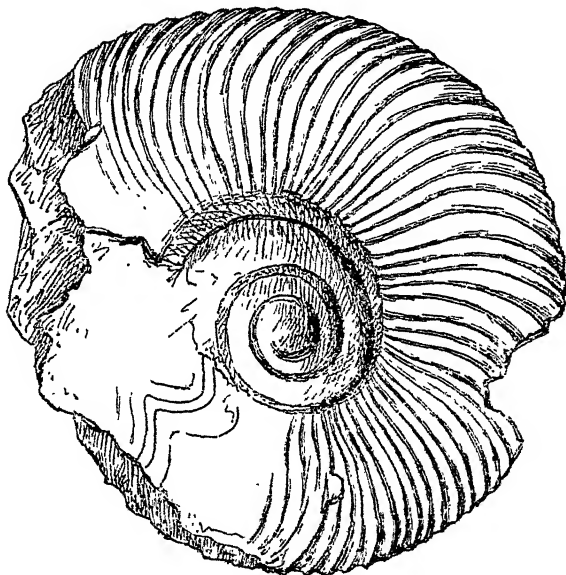
As the larger specimen is broken transversely across I
32*

Diameter of shell ..	79.5 mm. (100.0)	56.0 mm. (100.0)	40.0 mm. (100.0)
Width of umbilicus (at suture of shell)	25.5 " (32.0)	21.0 " (37.5)	16.0 " (40.0)
Width of umbilicus (at its margin) ..	33.5 " (42.1)	26.0 " (46.4)	22.0 " (55.0)
Height of outer whorl			
Ditto above preced- ing whorl			
Thickness of shell ..	43.0 " (54.0)	33.5 " (59.8)	29.5 " (73.7)

* See *infra*, p. 434.

defined; sides feebly convex, a little flattened near the umbilicus, and becoming more flattened and convergent on the body-chamber; umbilical zone well defined, narrow, almost perpendicular to the plane of symmetry of the shell. Body-chamber occupying nearly a complete whorl; aperture not seen, but the peristome (judging by the lines of growth) probably with a broad feeble lateral crest and a fairly deep

Fig. 2.



Periclytus trapezoidalis.—Lateral view of the type specimen, showing the ornaments of the shell, as well as some of the septa of the earlier portion of the outer whorl. Carboniferous Limestone: St. Doulagh's, Co. Dublin, Ireland. Drawn from an example in the collection of Dr. A. H. Foord, F.G.S. About three fifths natural size.

hyponomic sinus. Depth of chambers not seen; suture-line only imperfectly seen. Test ornamented with narrow prominent ribs, which pass obliquely backward from the umbilical margin, cross the lateral area in a feeble anteriorly convex curve, and form on the periphery a fairly deep and wide (hyponomic) sinus; interspaces flat, nearly twice as wide as the ribs; the whole surface of the ribs and interspaces (when well preserved) with fine close-set lines of growth, especially on the body-chamber. The outer whorl with numerous (nine or ten) constrictions, following the course of the ornaments

of the test. "Wrinkle-layer" composed of fine, regular, close-set longitudinal lines.

Dimensions.

Diameter of shell	141 mm. (100·0)
Width of umbilicus (at suture of shell)	49 " (34·7)
Width of umbilicus (at its margin)	53. " (37·5)
Height of outer whorl	51 (36·1)
Ditto above preceding whorl.....	about 30 (21·2)
Thickness of outer whorl	50 (35·4)

Remarks. I have seen only one example of this species—the type specimen—which is in the collection of Dr. A. H. Foord, F.G.S., of Dublin.

An unsuccessful attempt has been made to display the suture-line, the whorl having been ground away too deeply to show the precise form of this important character.

The "wrinkle-layer" is particularly well shown on the first portion of the last whorl.

The trivial name *trapezoidalis* refers to the form of the transverse section of the whorl of the adult shell.

Affinities and Differences. This species can be readily distinguished from all the other species of *Pericyclus* from the Carboniferous Limestone of Ireland that are known to me by the flattened trapezoidal form of the cross-section of its whorls and by their very distinct ornaments, which appear to be continued quite to the aperture of the shell.

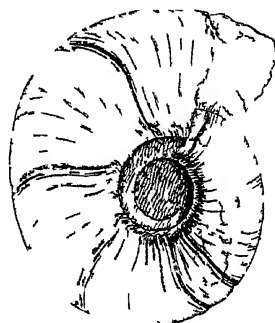
Horizon and Locality. Carboniferous Limestone: St. Douglagh's, Co. Dublin, Ireland.

Pericyclus rotuliformis, sp. n. (Fig. 3.)

Sp. char. Shell discoidal, somewhat compressed, rather rapidly increasing, with a moderately wide umbilicus; greatest thickness at the margin of the umbilicus, ranging from about three eighths to about three sevenths of the diameter of the shell; height of outer whorl ranging from about two fifths to about three eighths of the diameter of the shell. Whorls few (exact number unknown); inclusion two thirds; umbilicus shallow, with sloping sides and subangular margin, ranging from a little less to a little more than one third of the diameter of the shell in width, exposing the edges of all the inner whorls. Whorl subcordate in cross-section, a little higher than wide; indented to about one third of its height by the preceding whorl; periphery narrowly convex, imperfectly defined, continuous with the sides; sides feebly convex, somewhat flattened; umbilical zone fairly well defined, narrow, sloping towards the centre of the umbilicus

and making an obtuse angle with the sides. Body-chamber occupying rather more than an entire whorl, aperture not seen, but peristome (judging by the ornaments of the test) probably nearly straight on the lateral area and with a moderately wide and deep hyponomic sinus. Chambers (? depth), suture-line not seen. Test ornamented with feeble riblets

Fig 3



Periclytus rotuliformis —Lateral view of the type specimen, showing ornaments and well-marked constrictions of test. Carboniferous Limestone, St. Douglagh, Co. Dublin, Ireland. Drawn from an example in the collection of Dr. A. H. Foord, F.G.S. About three fifths natural size.

crossing the whorl obliquely backward as far as the margin of the periphery, and then passing abruptly backward, becoming somewhat coarser and more prominent, and forming on the periphery a moderately wide and deep hyponomic sinus, the outer whorl with seven or eight constrictions extending from the margin of the umbilicus and having a similar direction to the ornaments of the test, these constrictions being faintly indicated on the surface of the test, but well marked on internal casts.

Dimensions.

	(i)	(ii)	(iii)	(iv)
Diameter of shell	81 mm (100)	78 mm (100)	42 mm (100)	73.5 mm. (100)
Width of umbilicus (at suture of shell)	24 , (29.6)	23.5 , (30.1)	?	25 „ (34.0)
Width of umbilicus (at its margin)	29 , (37.5)	29.5 , (37.8)	16 mm (38.0)	31 „ (42.1)
Height of outer whorl	32.5 „ (40.1)	28 „ (35.8)	17 „ (40.4)	27.5 „ (37.4)
Ditto above preceding whorl	22 „ (27.1)	19* „ (24.3)	?	22 „ (29.9)
Thickness of outer whorl	32 , (39.5)	30* (38.4)	20 mm. (47.6)	32 „ (43.5)

* Approximately

Remarks. The example in Dr. Foord's collection that is selected as the type specimen is figured in the accompanying figure (fig. 3) and its dimensions are given above (i.). This appears to be the usual form of the species and is the chief basis of the above diagnosis. But besides this there is a form so closely related that it is considered to be specifically identical, in which the whorls are somewhat more inflated (being a little wider than high) and the umbilicus relatively wider than in the type specimen. The dimensions of such an example are also given above (iv.).

There are five examples of this species in Dr. Foord's collection, all from St. Doulagh's, Co. Dublin, Ireland. There are also two fragments (the locality of which is not recorded) in the British Museum collection (nos. C. 255 *a* & *b*) that are referred to this species with some doubt, especially the example C. 255 *b*. The specimen C. 255 *a* may have come from St. Doulagh's, but the matrix of the example C. 255 *b* differs somewhat from the usual matrix of the St. Doulagh's specimens.

Affinities and Differences. This species is easily distinguished from *Per. trapezoidalis** by its feebler ornaments and very pronounced constrictions, and from *Per. Foordi*† by its less inflated whorls and the presence of constrictions.

Horizon and Locality. Carboniferous Limestone: St. Doulagh's, Co. Dublin, Ireland.

Pericyclus clanensis, sp. n. (Figs. 4, 5.)

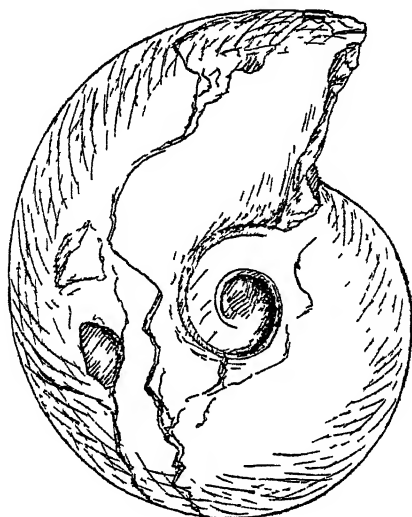
Sp. char. Shell discoidal, somewhat compressed, rather involute; greatest thickness at a short distance from the edge of the umbilicus, rather more than four elevenths of the diameter of the shell; height of outer whorl about three sevenths of the diameter of the shell. Whorls few (? number); inclusion nearly two thirds; umbilicus shallow, rather more than one fourth of the diameter of the shell in width, with rounded margin. Whorl semielliptical in cross-section, somewhat higher than wide; indented to rather more than one third of its height by the preceding whorl; periphery broadly convex, imperfectly defined; sides feebly convex, somewhat flattened near the umbilicus; umbilical zone narrow, convex, nearly perpendicular to the plane of symmetry of the shell, but sloping a little towards the umbilicus. Body-chamber occupying rather more than the last whorl; aperture not seen, but peristome (judging by the lines of

* See *supra*, p. 432.

† See *supra*, p. 430.

growth) probably with a feeble lateral crest and a broad and deep hyponomic sinus. Chambers shallow; suture-line as in

Fig. 4.



Pericyclus clanensis.—Lateral view of the type specimen. The specimen has been rubbed down so much, that there are only very slight indications of the ornaments of the test; these are not shown in the figure. Carboniferous Limestone: Clane, Co. Kildare, Ireland. Drawn from an example in the Science and Art Museum, Dublin. About three fifths natural size.

fig. 5. Test ornamented with coarse and rather irregular lines of growth, which pass from the umbilicus obliquely across the whorl, and at the margin of the periphery turn

Fig. 5.



Suture-line of *Pericyclus clanensis*.—Carboniferous Limestone: Clane, Co. Kildare, Ireland. Drawn of the natural size from the type specimen in the Science and Art Museum, Dublin.

abruptly backward, becoming somewhat more prominent and forming on the periphery a deep and fairly wide hyponomic

sinus ; the outer whorl with a few slight constrictions parallel to the lines of growth.

Dimensions.

Diameter of shell	117·5 mm. (100)
Width of umbilicus (at suture of shell)	31 " (26·8)
Width of umbilicus (at its margin) ..	33·5 " (28·5)
Height of outer whorl	49 " (41·7)
Ditto above preceding whorl	32 " (27·2)
Thickness of outer whorl	about 44 " (37·4)

Remarks. The example on which the present species is founded is in the Science and Art Museum, Dublin. It has been labelled *Goniatites Brownii*, M'Coy *, and there is just the possibility of its having been the type specimen. As it does not, however, agree either with M'Coy's figure or his description, I have entirely disregarded the name it bears. Since the example is from Clane, Co. Kildare, the name *Per. claneensis* is suggested for it.

Affinities and Differences. Compared with *Pericyclus rotuliformis* † and also *Per. Bailyi* this species has more inflated whorls and a much narrower umbilicus.

Horizon and Locality. Carboniferous Limestone: Clane, Co. Kildare, Ireland.

Pericyclus Bailyi, sp. n. (Figs. 6, 7.)

Sp. char. Shell discoidal, somewhat compressed, rather widely umbilicated; greatest thickness almost close to the umbilical margin, about four ninths of the diameter of the shell; height of outer whorl about three sevenths of the shell. Whorls about seven in number; inclusion three fourths; umbilicus deep, with subangular margin, nearly one third of the diameter of the shell in width. Whorl

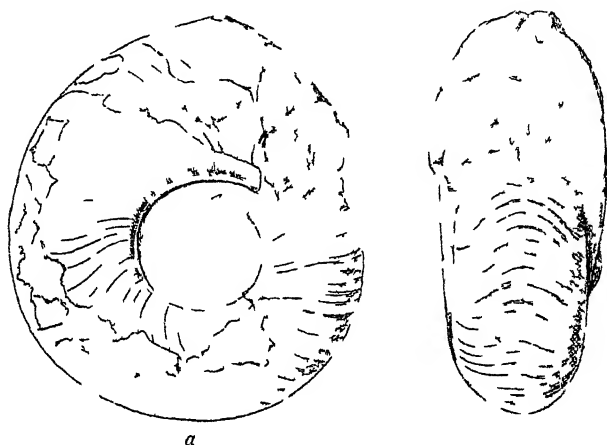
* F. M'Coy, Synopsis Carb. Foss. Ireland, p. 12, pl. iv. fig. 17. M'Coy's description of this species is as follows:—"Discoid, subglobose, sides flattened; umbilicus large, acute-edged, exceeding one third the diameter of the shell; surface smooth; septa, dorsal lobe small, bifid; dorsal sinus acute; first lateral lobe slightly exceeding the dorsal in length, very wide, rounded; lateral sinus twice as long as the dorsal, acute, linguiform; second lateral lobe very wide, obtusely rounded.

"From the *G. striatus*, Sow., which the species most resembles, it is distinguished internally by its much shorter and wider first lateral lobe; the same character distinguishes it from the *G. sphaericus*, Sow., and from both it is distinguished externally by its smooth surface, and from all the species of the same form by the large size of the umbilicus. Diameter 2 inches 2 lines, thickness 1 inch 1 line."

† See *supra*, p. 434.

semielliptical in section, a little wider than high; indented to about three eighths of its height by the preceding whorl; periphery rather broadly convex, imperfectly defined, sides

Fig 6



Pericyclus Bailyn—a lateral view of the type specimen b, front view of the same Carboniferous Limestone St Douglah's, Co Dublin, Ireland Drawn from an example in the British Museum Collection [C 298] About three fifths natural size

feebly convex, flattened near the umbilical margin; umbilical zone well defined, narrow, feebly convex, sloping towards the centre of the umbilicus, and forming an obtuse angle with the side. Body-chamber occupying the whole of the last whorl; aperture not seen, but peristome (judging by the lines of growth) probably almost straight on the lateral area and with a deep and broad hyponomic sinus. Chambers (? depth), suture-line as in fig 7 Test ornamented with

Fig 7



Suture-line of *Pericyclus Bailyn*—Carboniferous Limestone St Douglah's, Co Dublin Ireland Drawn of the natural size from an example in the collection of Dr A H Foord, FGS

feeble somewhat irregularly spaced riblets, which in crossing the whorl pass obliquely backward from the edge of the

umbilicus to near the edge of the periphery, where they are bent abruptly backward and form on the periphery a deep and wide hyponomic sinus; on the periphery the ornaments are stronger and more regularly arranged, the ribs being narrow and the interspaces a little wider than the ribs; at the anterior end of the body-chamber the riblets almost disappear both on the sides and on the periphery; the whole surface also with very fine raised lines, having the same direction as the riblets and crossing the inner area in a feeble anteriorly convex curve. "Wrinkle-layer" with minute blunt tubercles, which have a tendency to arrange themselves in transverse striæ near the umbilical portion of the whorl, while near the periphery they tend to dispose themselves in longitudinal striæ.

Dimensions.

	(i.)	(ii.)	(iii.)	(iv.)
Diameter of shell.....	97 mm. (100)	80 mm. (100)	62.5 mm. (100)	35 mm. (100)
Width of umbilicus (at suture of shell).	30 „ (30.9)	23 „ (28.7)	17 „ (27.1)	13 „ (37.1)
Width of umbilicus (at its margin).....	35 „ (36.2)	28 „ (35.0)	21 „ (33.6)	14 „ (40.0)
Height of outer whorl	41 „ (42.2)	32.5 „ (40.6)	26.5 „ (42.4)	14 „ (40.0)
Ditto above preceding whorl.....	26 * „ (26.8)	24 „ (30.0)	18 * „ (28.8)	10.5 „ (30.0)
Thickness of outer whorl	44 * „ (45.3)	39.5 „ (49.3)	31.5 „ (50.4)	19 „ (54.2)

Remarks. The present species is represented by four examples, the dimensions of which are given above. Three of these (ii., iii., and iv.) are in Dr. Foord's collection, the other (i.) is in the collection of the British Museum (no. C. 298). Compared with the adult, young examples have relatively wider whorls and a wider umbilicus in proportion to the diameter of the shell; they have also coarser ornaments. Up to a diameter of about 22 millim. the riblets pass over the margin of the umbilicus on to the umbilical zone of the whorl.

One of Dr. Foord's specimens (example ii. referred to above) shows the "wrinkle-layer" very clearly.

The example in the British Museum is labelled "*Goniatites Brownii*," apparently in Mr. Baily's handwriting, but the specimen agrees neither with M'Coy's figure nor with his description of that species †.

For this species the name *Pericyclus Bailyi* is proposed, after Mr. W. H. Baily, the late Palæontologist of the Geological Survey of Ireland.

* Approximately.

† See *supra*, p. 438, footnote.

Affinities and Differences. The present species is somewhat more inflated and more widely umbilicated than *Pericyclus clanensis* *; it is also more inflated than *Pericyclus rotuliformis* †, and lacks the constrictions characteristic of that species.

Horizon and Locality. All the examples of this species that I have seen are from St. Doulagh's, Co. Dublin, Ireland. Three of these are in Dr. Foord's collection, and one (the largest) is in the British Museum collection (no. C. 298).

Pericyclus plicatilis, L. G. de Koninck, sp.

Goniatites plicatilis, L. G. de Koninck, "Sur quelques Céphalopodes nouveaux du Culcaire carbonifère de l'Irlande," Ann. Soc. géol. de Belg. vol. ix., Mémoires, p. 55, pl. v. figs. 3 & 4 (erroneously stated to be pl. vi. figs. 3 & 4 (1851)).

Sp. char. Shell subglobose, rather widely umbilicated; greatest thickness at the umbilical margin, about two thirds of the diameter of the shell; height of outer whorl about two fifths of the diameter of the shell. Whorls (? number); inclusion five sixths; umbilicus deep, with angular margin and steep sides, about one third of the diameter of the shell in width, exposing the angular edges of the inner whorls. Whorl semilunate in cross-section, much wider than high; indented to about two thirds of its height by the preceding whorl; periphery broadly convex, imperfectly defined, continuous with the sides; sides feebly convex; umbilical zone well defined, fairly wide, nearly perpendicular to the plane of symmetry of the shell, but sloping a little towards the centre of the umbilicus. Body-chamber apparently occupying nearly the whole of the last whorl; aperture not seen, but (judging by the direction of the growth-lines) the peristome probably nearly straight on the lateral area, and with a very broad and fairly deep hyponomic sinus. Chambers (? depth); suture-line only partially seen. Test ornamented with narrow prominent riblets, which pass from the margin of the umbilicus in a nearly radial direction over about two thirds of the lateral area, and then turn backward somewhat abruptly, forming on the periphery a very broad and fairly deep hyponomic sinus; the interspaces are somewhat wider than the riblets; the whole surface with very fine growth-lines parallel to the riblets.

Dimensions. Owing to the distortion of the specimen I

* See *supra*, p. 436.

† See *supra*, p. 434.

give the dimensions at two diameters (A-B, C-D) as nearly as possible at right angles to each other:—

	A-B.	C-D.
Diameter of shell	about 96 mm. (100)	74 mm. (100)
Width of umbilicus (at suture of shell)	32.5 „ (33.8)	22 „ (29.7)
Width of umbilicus (at its margin)	40 „ (41.6)	30 „ (40.5)
Height of outer whorl	about 33 „ (34.3)	31 „ (41.8)
Ditto above preceding whorl . .	20 „ (20.8)	20 „ (27.0)
Thickness of outer whorl	about 64 „ (66.6)	53 „ (71.6)

The dimensions given by De Koninck are:—longitudinal diameter 85 millim.; transverse diameter 58 millim.; diameter of umbilicus 30 millim.; median height of aperture 21 millim.

Remarks. The only example of this species that I have seen is De Koninck's type specimen, which is in the collection of the Geological Survey of Ireland. It is there labelled "*Goniatites Wrightii*," but this appears to be only a manuscript name. There is, however, no doubt whatever about its being the type specimen of De Koninck's "*Goniatites platicatilis*." The locality of the specimen is not recorded on the tablet to which it is fixed; but De Koninck says:—"Un certain nombre [sic] de spécimens de cette espèce ont été recueillis dans le calcaire de Kilmacan." De Koninck's figure is somewhat restored, the specimen being of a more elliptical form.

Affinities and Differences. The present species is clearly allied to *Per. subplicatilis*, but that is a much less inflated shell. From *Per. Hauchecornei*, Holzappel*, it differs by its coarser ornaments and its much more inflated whorls.

Horizon and Locality. Carboniferous Limestone: Kilmacan, Ireland (*vide* de Koninck).

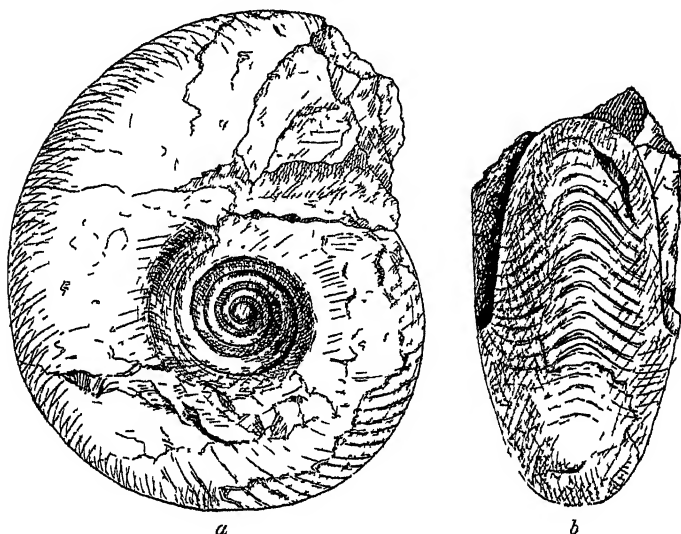
Pericyclus subplicatilis, sp. n. (Figs. 8, 9.)

Sp. char. Shell discoidal, somewhat compressed, moderately widely umbilicated; greatest thickness almost close to the margin of the umbilicus, about two fifths of the diameter of the shell; height of outer whorl about two fifths of the diameter of the shell. Whorls six or seven; inclusion four fifths; umbilicus rather deep, with subangular margin, exposing the edges of the inner whorls, about three tenths of the diameter of the shell in width. Whorl semielliptical in cross-section,

* "Die Cephalopoden-führenden Kalke des unteren Carbon von Erdbach-Breitscheid bei Herborn." Pal. Abhandl., Dames & Kayser, Bd. v. Heft 1, 1889, p. 86, pl. ii. figs. 8-11 (especially figs. 11 & 11 a).

about as high as wide; indented to about one fifth of its height by the preceding whorl; periphery broadly convex, imperfectly defined; sides feebly convex, somewhat flattened

Fig. 8



Pericyclus subplicatilis—*a*, lateral view of the type specimen; *b*, peripheral view of the earlier portion of the outer whorl of the same. Carboniferous Limestone: St. Doulagh's, Co. Dublin, Ireland. Drawn from an example in the collection of Dr. A. H. Foord, F.G.S. About three fifths natural size.

near the umbilical margin; umbilical zone narrow, well-defined, nearly perpendicular to the plane of symmetry of the shell. Body-chamber occupying the whole of the last whorl; aperture not seen, but (judging by the growth-lines and orna-

Fig. 9.



Pericyclus subplicatilis.—Suture-line. Carboniferous Limestone: St. Doulagh's, Co. Dublin, Ireland. Drawn from an example in the collection of Dr. A. H. Foord, F.G.S. Natural size.

ments) the peristome probably nearly straight on the lateral area, and with a deep and broad hyponomic sinus. Chambers (? depth); suture-line as in fig. 9. Test ornamented with

feeble somewhat inequidistant ribs, which, arising at the umbilical margin, pass thence obliquely backward as far as the margin of the periphery, where they bend somewhat abruptly backward, and form on the periphery a deep and wide hyponomic sinus; on the periphery the ribs become nearly equidistant, fairly coarse, and separated by interspaces of about their own width; the ornaments gradually disappear on the outer whorl, those on the lateral area disappearing first, and the ribs on the periphery at about the middle of the last whorl. The whole surface of the test with very fine growth-lines.

Dimensions.

Diameter of shell	113.5 mm.*	(100)
Width of umbilicus (at suture of shell)	33	" (23.0)
Width of umbilicus (at its margin) ..	40	(35.2)
Height of outer whorl	43.5	(38.3)
Ditto above preceding whorl	about 35	(30.8)
Thickness of outer whorl	44	(38.7)

Remarks. I have seen only two examples of the present species; they are both in the collection of Dr. A. H. Foord, of Dublin. The larger of these is fairly well preserved and is regarded as the type specimen (see fig. 8 *a, b*). The smaller example has a very imperfect and somewhat distorted outer whorl, but exhibits the sculpture of the shell at a diameter of about 62 millim., and shows that the ribbing becomes obsolete on the body-chamber at a diameter of about 94 millim. I have been able to display the suture-line in this specimen where the diameter is about 51 millim., *i. e.* where the radius of the shell is about 29 millim. (see fig. 9).

Affinities and Differences. Of the Irish *Goniaticites* that are known to me the sculpture of the present species (up to a diameter of about 70 millim.) closely resembles that of De Koninck's *Goniaticites plicatilis* †; but that is a very much more inflated shell, and the umbilical zone of its outer whorl is wider and more sloping than that of the present species. This species appears to be also related to *Pericyclus clunensis* ‡,

* This specimen has been broken across and the fissure filled with calcite, so that the diameter of the shell and the height of the last whorl appear to be greater than they really are; the diameter appears to be 122 millim. and the height of the outer whorl 55.5 millim.

† L. G. de Koninck, "Sur quelques Céphalopodes nouveaux du Calcaire carbonifère de l'Irlande," *Aun. Soc. géol. de Belg.* vol. ix., *Mémoires*, p. 55, pl. v. figs. 3 & 4 (erroneously stated to be pl. vi. figs. 3 & 4). See *supra*, p. 441.

‡ See *supra*, p. 436.

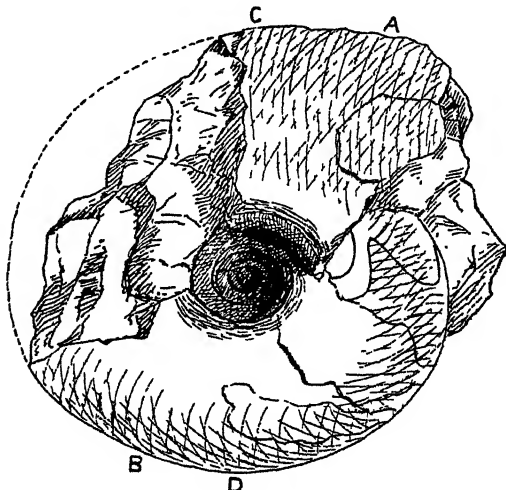
but its inner whorls are less inflated, its umbilicus wider, its umbilical margin more prominent, and the umbilical zone of its outer whorl wider than in that species.

Horizon and Locality. Both examples that I have seen are from the Carboniferous Limestone of St. Doulagh's, Co. Dublin, Ireland.

Glyphioceras cordatum, sp. n. (Figs. 10, 11.)

Sp. char. Shell discoidal, inflated, rather narrowly umbilicated; greatest thickness at a short distance from the umbilical margin, a little more than one half of the diameter of the shell; height of outer whorl a little less than one half of the diameter of the shell. Whorls (? number); inclusion about five sixths; umbilicus deep, with angular margin and steep sides, about

Fig. 10.



Glyphioceras cordatum.—*a*, lateral view of the type specimen; the last septum is seen near the commencement of the outer whorl. Carboniferous Limestone: Little Island, Cork, Ireland. Drawn from an example in the collection of Dr. A. H. Foord, F.G.S. About three fifths natural size.

one fourth of the diameter of the shell in width. Whorl cordate in cross section, a little wider than high; indented to nearly one half of its height by the preceding whorl; periphery narrowly convex and imperfectly defined by an obtuse ridge on each side, becoming acute near the aperture of the shell; sides feebly convex, with an obtuse ridge at

about three fifths of the width of the side from the edge of the umbilicus, that becomes obsolete on the anterior part of the body-chamber; umbilical zone well defined, rather narrow, nearly perpendicular to the plane of symmetry of the shell. Body-chamber occupying the whole of the last whorl; aperture not seen, but (judging by the growth-lines of the test) the peristome probably with a prominent lateral crest and a deep and rather narrow hyponomic sinus. Chambers rather shallow; suture-line as in fig. 11. Test nearly smooth,

Fig. 11.



Glyptoceras cordatum.—Suture-line drawn from the last septum of the type specimen in the collection of Dr. A. H. Foord, F.G.S. Carboniferous Limestone: Little Island, Cork, Ireland. Natural size.

apparently with only growth-lines which have a nearly radial direction on the inner portion of the lateral area and turn somewhat abruptly backward on the outer portion so as to form a deep and moderately wide hyponomic sinus on the periphery; internal cast nearly smooth.

Dimensions.

	A-B.	C-D.
Diameter of shell	116.5 mm. (100)	109.5 mm. (100)
Width of umbilicus (at suture of shell)	26 " (22.3)	24.5 " (22.3)
Width of umbilicus (at its margin)	28.5 " (24.4)	26 " (23.7)
Height of outer whorl	about 51.5 " (44.2)	about 48.5 " (41.2)
Ditto above preceding whorl	about 27.5 " (23.6)	about 25 " (22.8)
Thickness of outer whorl	56 " (48)	55.5 " (50.6)

Remarks. I have seen only two examples of this species. They are both from Little Island, Cork, and in the collection of Dr. A. H. Foord, of Dublin. As is usual with specimens from this locality, both are distorted, the one (the dimensions of which are given above) only slightly, but the other so much that its measurements are not given, since they would be misleading. There cannot, however, be any doubt as to the specific identity of the specimens.

The trivial name has been suggested by the form of the aperture of the shell.

Affinities and Differences. This species is evidently closely

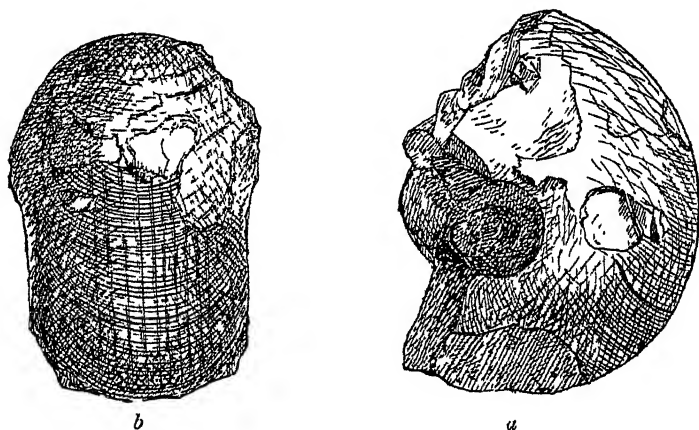
related to such forms as *Glyphioceras reticulatum*, J. Phillips, sp.*, and *Glyphioceras Davisi*, Foord & Crick †, but from the former it differs by its more inflated whorls, the form of its umbilicus, and the nature of its suture-line, and from the latter by its angular but not prominent umbilical margin and the form of its suture-line.

Horizon and Locality. Both examples that are referred to this species are from the Carboniferous Limestone of Little Island, Cork, Ireland.

Glyphioceras corpulentum, sp. n. (Figs. 12, 13.)

Sp. char. Shell subglobose, umbilicated, rapidly increasing; greatest thickness at the umbilical margin, about three fifths of the diameter of the shell; height of outer whorl about three sevenths of the diameter of the shell. Whorls

Fig. 12.



Glyphioceras corpulentum.—*a*, lateral view of the type specimen; *b*, peripheral view of the same, showing the longitudinal and transverse ornaments of the test. Carboniferous Limestone: St. Doulagh's, Co. Dublin, Ireland. Drawn from an example in the collection of Dr. A. H. Foord, F.G.S. About three fifths natural size.

few (? number); inclusion nearly complete; umbilicus deep, with subangular margin and steep sides, about three tenths of

* J. Phillips, Geol. Yorks. pt. ii. 1836, p. 235, pl. xix. figs. 26-32. See also A. H. Foord & G. C. Crick, Cat. Foss. Ceph. Brit. Mus. pt. iii. 1897, p. 193.

† A. H. Foord & G. C. Crick, Cat. Foss. Ceph. Brit. Mus. pt. iii. 1897, p. 198, fig. 95.

the diameter of the shell in width. Whorl lunate in cross-section, the height about three fourths of the width; indented to nearly one half of its height by the preceding whorl; periphery broadly convex, imperfectly defined; sides convex; umbilical zone well defined, narrow, almost perpendicular to the plane of symmetry of the shell. Body-chamber occupying nearly the whole of the last whorl; aperture not seen, but (judging by the growth-lines) the peristome probably with only a very feeble crest near the edge of the umbilicus, and with a very wide and shallow hyponomic sinus. Chambers shallow; suture-line as in fig. 13. Test nearly smooth, with

Fig. 13.



Glyphioceras corpulentum.—Suture-line drawn from an example in the collection of Dr. A. H. Foord, F.G.S. Carboniferous Limestone: St. Doulagh's, Co. Dublin, Ireland. Natural size.

fine subregular raised lines, which become more distinct in the adult; these pass obliquely backward from the umbilicus as far as the margin of the periphery, where they assume a nearly radial direction, and cross the periphery in a very wide and shallow hyponomic sinus; in the adult the periphery bears eight or nine obscure rather widely spaced longitudinal lines.

Dimensions.

	(i.)	(ii.)
Diameter of shell	64 mm. (100)	95 mm. (100)
Width of umbilicus (at suture of shell)	15.5 " (24.2)	22 " (23.1)
Width of umbilicus (at its margin)	21 " (32.8)	25 " (26.3)
Height of outer whorl	27 " (42.1)	45 " (47.3)
Ditto above preceding whorl	about 16.5 " (25.7)	about 20 " (21.0)
Thickness of outer whorl.	40.5 " (63.2)	58 " (61.0)

Remarks. The two examples of this species that I have seen are in the collection of Dr. A. H. Foord. Their dimensions are given above. The larger specimen (ii.) shows the form of the inner whorls and is regarded as the type, the smaller example (i.) exhibits the suture-line.

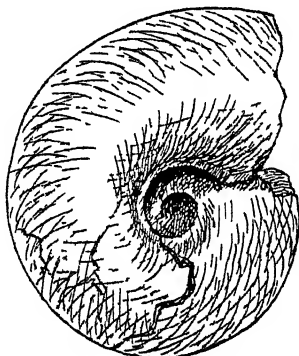
Affinities and Differences. This species can be readily recognized by the nature of its ornaments and by the inflation of its whorls.

Horizon and Locality. Both examples known to me are from the Carboniferous Limestone, St. Doulagh's, Co. Dublin, Ireland.

Glyphioceras ellipsoidale, sp. n. (Fig. 14.)

Sp. char. Shell subglobose, somewhat compressed, narrowly umbilicated; greatest thickness at the margin of the umbilicus, about four sevenths of the diameter of the shell; height of outer whorl about three sevenths of the diameter of the shell. Whorls (? number); inclusion about two thirds; umbilicus deep, with subangular margin and nearly perpendicular sides, about three elevenths of the diameter of the

Fig. 14.



Glyphioceras ellipsoidale.—Lateral view of the type specimen in the collection of the Museum of Science and Art, Dublin. Carboniferous Limestone: Kildare, Ireland. About three fifths natural size.

shell in width, exposing the edges of the inner whorls. Whorl semielliptical in cross-section, the height about three fourths of the width; indented to nearly one third of its height by the preceding whorl; periphery broadly convex, imperfectly defined, continuous with the sides; sides convex, a little flattened near the umbilicus; umbilical zone narrow, convex, nearly perpendicular to the plane of symmetry of the shell. Body-chamber apparently occupying the whole of the last whorl; peristome with a broad, feeble, lateral crest and a wide and deep hyponomic sinus. Chambers (? depth); suture-line not seen. Test almost perfectly smooth, with obscure growth-lines near the aperture.

Dimensions.

	(i.)		(ii.)	
Diameter of shell ..	83 mm. (100)	70.5 mm. (100)	70.5 mm. (100)	
Width of umbilicus (at suture of shell)	20 „ (24.0)	?	14 „ (19.8)	
Width of umbilicus (at its margin) ..	23.5 „ (28.3)	17.5 mm. (24.8)	17 „ (24.1)	
Height of outer whorl	36 „ (43.3)	31.0 „ (43.0)	31.5 „ (44.6)	
Ditto above pre- ceding whorl ..	25 „ (30.1)	?	21 „ (29.7)	
Thickness of outer whorl	47 „ (56.6)	43 mm. (60.9)	39.5 „ (56)	

Remarks. The type specimen of this species—the example upon which the diagnosis given above has been chiefly based—is in the collection of the Museum of Science and Art, Dublin. The specimen is labelled “Kildare,” and does not appear to be at all crushed or distorted. The whole of the outer whorl appears to be occupied by the body-chamber, so that I have not been able to make out the form of the suture-line. With some doubt I also refer to this species an example in the British Museum collection (no. C. 294) from the Carboniferous Limestone of Rathkeale, Co. Limerick; but, as will be seen from its dimensions given above (ii.), it is somewhat more compressed than the type specimen, but some of this compression may have been produced during fossilization. De Koninck recognized three divisions of the Carboniferous Limestone in Ireland—upper, middle, and lower; he referred the limestone at Rathkeale to the middle division, whilst that at Kildare he placed in the upper division.

Affinities and Differences. This species differs from *Gly. sphaericum*, Martin, sp.*, in being less inflated and more umbilicated. Compared with *Gly. crenistria*, Phillips, sp.†, it is more compressed, its ornaments are not crenulated, and they form a much deeper hyponomic sinus. Its transverse ornaments (or growth-lines), larger umbilicus, and more inflated shell at once distinguish this species from *Gly. striatum*‡, J. Sowerby, sp.

* *Conchylolithus Nautilites sphaericus*, W. Martin, Petrif. Derb. 1809, p. 15, pl. vii. figs. 3, 4, & 5.

† *Goniatites crenistria*, J. Phillips, Geol. Yorks. pt. ii. 1836, p. 234, pl. xix. figs. 7, 8, 9.

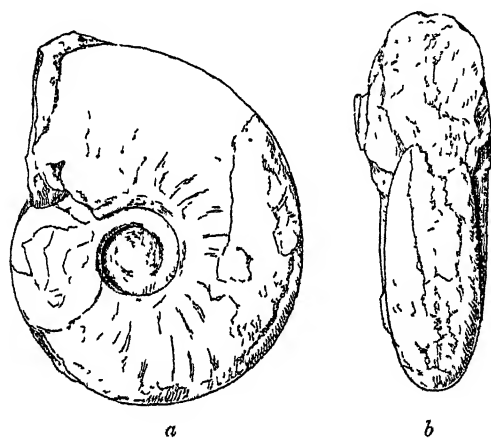
‡ *Ammonites striatus*, J. Sowerby, Min. Conch. vol. i. p. 115 (1814), pl. liii. fig. 1.

Horizon and Locality. Carboniferous Limestone: Kildare, Ireland (? Rathkeale, Co. Limerick, Ireland).

Prolecanites Leasoni, sp. n. (Fig. 15.)

Sp. char. Shell discoidal, compressed, rather narrowly umbilicated; greatest thickness at the margin of the umbilicus, about one third of the diameter of the shell; height of outer whorl about four ninths of the diameter of the shell. Whorls (? number); inclusion three fourths; umbilicus shallow, with subangular margin and sloping sides, about two sevenths of the diameter of the shell in width. Whorl

Fig. 15.



Prolecanites Leasoni.—*a*, lateral view of the type specimen; *b*, front view of the same. Carboniferous Limestone: Glenbane East, Limerick, Ireland. Drawn from an example in the collection of the Geological Survey of Ireland, Dublin. About three fifths natural size.

subtrapezoidal in cross-section, its width about three fourths of its height; indented to about two sevenths of its height by the preceding whorl; periphery somewhat imperfectly defined, very feebly convex, somewhat flattened; umbilical zone narrow, well defined, sloping towards the centre of the umbilicus. Body-chamber apparently occupying nearly the whole of the last whorl; aperture not seen, but (judging by the growth-lines) the peristome probably nearly straight on the lateral area, and with a fairly wide and moderately deep hyponomic sinus. Chambers (? depth); suture-line not seen. Test nearly smooth, with subregular growth-lines, which

have a nearly radial direction on the lateral area and form a fairly wide and moderately deep hyponomic sinus on the periphery; the body-chamber with obscure backwardly curved riblets extending from the edge of the umbilicus over about one third of the lateral area; the internal cast has on the first fourth of the outer whorl two constrictions, which arise at a short distance from the edge of the umbilicus and cross the whorl parallel to the growth-lines.

Dimensions.

Diameter of shell	90 mm. (100)
Width of umbilicus (at suture of shell).....	24 „ (26·6)
Width of umbilicus (at its margin)	27 „ (30·0)
Height of outer whorl	40·5 „ (45·0)
Ditto above preceding whorl	28 „ (31·1)
Thickness of outer whorl.....	20·5 „ (32·8)

Remarks. I have seen only one example of this species; it is in the collection of the Geological Survey of Ireland, and I am greatly indebted to the authorities of the Survey for the loan of the specimen. It is there labelled "*Goniatites Leasoni*," but, so far as I know, no description of the species has been published under this name. Unfortunately the suture-line cannot be made out; but there is every reason to believe that the species belongs to the genus *Prolecanites*.

Affinities and Differences. The present species can be readily distinguished from both *Prolecanites compressus*, J. Sowerby, sp.*; and *Prolec. similis*, Crick †, by the smallness of its umbilicus.

Horizon and Locality. Carboniferous Limestone: Glenbane East, Limerick, Ireland. This is the same locality as that which yielded the type specimen of L. G. de Koninck's *Goniatites ornatissimus* ‡.

* J. Sowerby, Min. Conch. vol. i. p. 84, pl. xxxviii, 1813 (*Ellipsolites compressus*). See also Foord & Crick, "On the Identity of *Ellipsolites compressus*, J. Sowerby, with *Ammonites Henslowi*, J. Sowerby," Geol. Mag. dec. iv. vol. i. (1894), p. 11, pl. i.

† G. C. Crick, Trans. Manchester Geol. Soc. vol. xxiii. pt. iii. 1895, pp. 80-84, woodcut.

‡ L. G. de Koninck, "Sur quelques Céphalopodes nouveaux du Calcaire carbonifère de l'Irlande," Ann. Soc. géol. de Belg. vol. ix., Mémoires, p. 55, pl. vi. figs. 3 & 4 (erroneously stated to be pl. v. figs. 3 & 4). See also *infra*, p. 453.

Brancoceras ornatissimum, L. G. de Koninck, sp.

Goniatites ornatissimus, L. G. de Koninck, "Sur quelques Céphalopodes nouveaux du Calcaire carbonifère de l'Irlande," *Ann. Soc. géol. de Belg.* vol. ix., Mémoires, p. 53, pl. vi. figs. 4 & 5 (erroneously stated to be pl. v. figs. 4 & 5) (1881).

Sp. char. Shell somewhat ovoidal, compressed, with closed umbilicus; greatest thickness at about one fourth of the height of the whorl from the umbilicus, about seven tenths of the diameter of the shell; height of outer whorl about three fifths of the diameter of the shell. Whorls (? number); inclusion complete; umbilicus closed with shelly callus, in centre of infundibuliform depression. Whorl oval or subcordate in cross-section, rather wider than high; indented to about one half of its height by the preceding whorl; periphery narrowly convex, imperfectly defined; sides feebly convex, convergent, their inner portion sloping towards the umbilicus and forming an obtuse angle with the rest of the side; no distinct umbilical zone. Body-chamber probably occupying fully half a whorl; aperture not seen, but (judging by the ornaments) the peristome probably with a broad lateral crest and a deep and fairly wide hyponomic sinus. Chambers (? depth); suture-line only imperfectly seen; external lobe narrow, with a single point, external saddle rounded, fairly wide; lateral lobe with a single point, somewhat wider than the external lobe; lateral saddle very broad, rounded, twice as wide as the external saddle. Test with fine regular raised lines, which cross the lateral area of the whorl in a bold orad-convex curve, and form on the periphery a deep and fairly wide hyponomic sinus.

Dimensions.

Diameter of shell	68 mm. (100)
Width of umbilicus	(closed)
Height of outer whorl	41.5 mm. (61.0)
Ditto above preceding whorl	23 " (33.8)
Thickness of outer whorl.....	47 " (69.1)

The dimensions given by De Koninck are:—longitudinal diameter 70 millim.; transverse diameter 42 millim.; height of aperture 40 millim.

Remarks. I have seen only one example of this species, that is the type specimen which forms part of the collection of the Geological Survey of Ireland; it bears the locality "Limerick, Glenbane El.;" but De Koninck says it came

from Tomdeelys, Co. Limerick, Ireland. The specimen lacks the body-chamber, the anterior end of the specimen being the surface of the last septum. Although this septal surface is incomplete, there is sufficient to show clearly that the species belongs to the genus *Brancoceras*. This was the only example known to De Koninck.

Affinities and Differences. The closed umbilicus, the wide umbilical depression, the ornaments of the test, and the form of the suture-line at once distinguish the present species both from *Glyphioceras striatum*, J. Sowerby, sp., and *Glyphioceras crenistria*, J. Phillips, sp.

LX.—*Note on the Occurrence of Cytheridea castanea, G. S. Brady, in a Surface-deposit in the Vicinity of Buenos Ayres, South America.* By THOMAS SCOTT, F.L.S.

[Plate XVI.]

DARWIN, when describing the surface-geology of the Pampas in his 'Geological Observations on South America,' alludes to the occurrence of shell-bearing sand-dunes on the shores of the Rio de la Plata and elsewhere in the province of La Plata. Numbers of these dunes are to be found in the vicinity of Buenos Ayres, especially towards the shores of the estuary of the Plate. The dunes referred to are generally more or less covered with vegetation, but in some instances, where the vegetation is displaced, a shell-bed a few inches thick and of a darker colour and firmer consistency than the sand is seen to stretch across each of the dunes in a nearly horizontal position. It is in this shell-bed that the *Cytheridea* was obtained that forms the subject of this note.

Buenos Ayres, being an important seaport, is frequently visited by ships trading to South America. My younger son, Mr. John Scott, is a marine engineer, and his ship happened to be at Buenos Ayres for several days during January last year (1898). My son is interested in natural history, and, being ashore, he took the opportunity to examine a few of the sand-dunes in the vicinity of the harbour of Buenos Ayres and also to collect a quantity of the material in which the shells are embedded. In collecting this material he first scraped away the surface-matter, then, digging well into the shell-bed, removed what he considered to be a fair sample of the material; this he brought home on his return to England. I made a careful examination of the material my son had brought to me, and obtained from it a number of different kinds of fossils; the most common species obtained was *Azara* [The text is cut off here in the original document.]

abundant in the sand-dunes near San Pedro on the River Paraná and in shell-beds at San Isidro. The remains of this mollusk occurred mostly in the form of single valves or portions of valves, only in a few instances were the specimens complete, and in every case the valves of the more perfect specimens were kept together only by the mud in which they were embedded. *Paludistrina*, a small spiral univalve, was also moderately frequent. The remains of a small *Balanus* were occasionally observed, and one or two of the valves of *Azara* had each a *Balanus* adhering to them. A few Foraminifera, seeds of plants, and some other things were also noticed; but the most interesting of all the fossils obtained was the Ostracod already referred to, viz. *Cytheridea castanea*, G. S. Brady.

Cytheridea castanea was described and figured by Prof. Brady in 1870 in 'Les Fonds de la Mer,' vol. i. p. 117, pl. xiii. figs. 19-21, pl. xiv. figs. 1, 2*. This Ostracod was dredged by the Marquis de Folin in the Bay of Biscay and at Port Said, and these two places are apparently the only localities where the species has been obtained hitherto. Prof. Brady very kindly examined a few of the Buenos Ayres specimens, and is satisfied that they belong to the same species as his *Cytheridea castanea*. I may mention, however, that in all the specimens from Buenos Ayres which I have observed there is a slight depression that extends obliquely across both valves of the Ostracod, as shown by figures 2 and 3 (Pl. XVI.). In some of the specimens the depression is scarcely so conspicuous as it is in others, and it is best seen when the light strikes lengthways across the shell. *Cytheridea castanea* does not appear to have previously been recorded from South America even as a fossil; its occurrence in the shell-bed at Buenos Ayres is therefore of interest, more especially as it appears to be moderately frequent in the deposit. I have obtained a considerable number of specimens in the sample of the deposit which my son brought home, and, curiously, it was the only Ostracod observed.

Prof. Rupert Jones, to whom I desire to express my indebtedness for information concerning the fossil Entomostraca of South America, has published one or two papers in which are described a number of forms that were obtained during the excavations for a new railway in Bahia†. The

* See also the "Mon. of the Mar. and Freshw. Ostrac. of the N. Atlantic and N.W. Europe," Trans. Roy. Dubl. Soc. vol. iv. ser. 2, p. 175, pl. xxi. figs. 3, 4 (1889).

† "Fossil Entom. from S. America," Geol. Mag. dec. iv. vol. iv. pp. 259-265 & 289-293, pls. ix., x. (1897).

species recorded by Prof. Jones include several Ostracoda, but none of them appear to belong to the *Cytheridea* referred to here. Moreover, the shell-bed in which this Ostracod occurs is apparently referable to a later date than the deposit in which the Bahia fossils were obtained that are described by Prof. Jones.

The *Azara* is said to be still living in the estuary of the Plata, and probably the *Cytheridea* may also be still living there; for if the same conditions that were suitable to the existence of the *Azara* when the bed in which they are now found fossil was being formed were also congenial to the *Cytheridea*, it is reasonable to suppose that the conditions under which the mollusk is living now will also be favourable to the existence of the Ostracod.

The figures on the annexed Plate XVI. represent (1) a sketch (fig. 1), drawn from memory by Mr. John Scott, of two of the dunes, to indicate approximately the position of the shell-beds in which the fossils occur, and (2) two drawings (figs. 2 and 3) by Mr. A. Scott, showing a lateral and a dorsal view of the Ostracod, prepared from Buenos Ayres specimens.

LXI.—*Embryology of Ophiocoma echinata, Agassiz.*
(Preliminary Note.) By C. GRAVE*.

THE conflicting results of previous investigators, and the need of confirmation of some of the results obtained by them upon Ophiurid development, seemed to warrant my undertaking a new investigation of the subject; and by the advice of Prof. W. K. Brooks it was made my principal object while in Jamaica during the summer of 1897 to obtain a series of embryological material extending at least from the segmentation stages to the beginning of metamorphosis.

But when I arrived at Port Antonio on June 14th I found that in no species at hand had the breeding-season begun except with *Ophiocoma Riisei*, with which it was over, and it was not until less than three weeks of the end of my stay that the first ripe eggs were thrown by *Ophiocoma echinata*, although ripe spermatozoa had been obtained every day for more than a month.

In consequence of this the oldest plutei reared were but

* From the 'Johns Hopkins University Circulars,' November 1898, pp. 6-7.

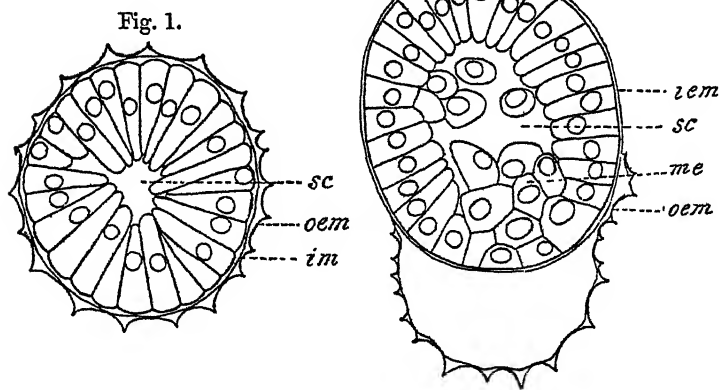
sixteen days old and showed no signs of metamorphosis, but probably had reached their adult form and size.

The eggs, which were of an orange-red colour, after being fertilized, threw about themselves a tough prickly egg-membrane, which rendered preservation difficult until it was burst and the larva had escaped.

At first the points and ridges of this chitinous egg-membrane were quite high and regular, but soon were worn down and became as shown in figure 1. Under the outer egg-membrane is still another, very thin and closely applied to the developing larva.

Segmentation was regular, and a blastula was formed, consisting of cells of equal size or nearly so, and with a very small segmentation-cavity. The long cylindrical cells composing its walls before dividing flatten down and become as nearly spherical as conditions will admit, as has been described by Korschelt for sea-urchins and as is shown for *O. echinata* in figure 1, which is a camera sketch of a section

Fig. 2.



of a blastula. The growing larva now bursts the chitinous membrane which encloses it, crawls out, and swims about in the water. It is somewhat elongated and swims in the direction of the axis connecting the animal and vegetable poles, the animal pole, which is slightly pointed, preceding.

As it moves from place to place it is continually revolving on the long axis. At the time of hatching the mesenchyme formation has just begun. It takes place by the rapid proliferation of cells at the vegetable pole, no evidence being

found of its originating as two bands, and is continued until the segmentation-cavity is quite crowded with cells. Figure 2 is a camera sketch of a section of a larva at the time of hatching, cutting it in the plane of the long axis, showing the shape of the larva at this stage and the method of mesenchyme formation.

The cilia did not show in the section, but those at the animal pole are much longer than those over the rest of the larva.

The gastrula-stage is formed several hours later by the invagination of the vegetable pole. The cells composing the invaginated tube or archenteron are all of about the same shape and size, but a decided differentiation is to be noted among the ectoderm cells. Those at the animal pole are much elongated and vacuolated, thus forming a thickened apical plate. The lateral walls, too, have each a thickened area, while the cells of the ventral side are of a uniform thickness, but much thicker than those composing the dorsal surface of the larva, which are much flattened and thin. Near the thickened lateral areas clumps of mesenchyme cells collect and begin to secrete the larval skeleton. Beside these, other mesenchyme cells take up the function probably of support for the archenteron and other organs as they form. At least in gastrulæ and older larvæ long branching cells can be seen in the segmentation-cavity connecting the archenteron with the ectoderm wall or with other mesenchyme cells, or connecting two portions of the ectoderm. The cells of the supported parts to which the processes of the mesenchyme cells attach take an active part in the formation of the connecting fibre or strand, as part of their substance meets and fuses with that sent out by the mesenchyme cell.

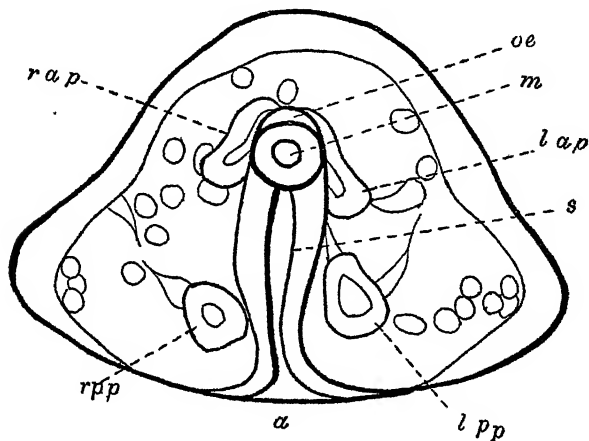
From the apex of the flattened archenteron a pair of pouches grow out and are constricted off, one to the right, the other to the left. Each of these divides into two pouches of about equal size, one of which remains in about its original position, while the other migrates toward the blastophore and takes up a position on the side of that part of the archenteron which will later become the stomach. This is as Metschnikoff described it and as Bury supposed must be the case; but, contrary to what both the above investigators describe, I find that the right posterior pouch degenerates and disappears, thus leaving a larva with a pouch on either side of the œsophagus and one on the left side of the stomach. This condition was noted in every pluteus observed, and hundreds of them have been studied.

In confirmation of the phenomenon observed in Ophiurans

by Metschnikoff and in starfish larvæ by Brooks and Field, I find that soon after their formation the two anterior pouches both communicate with the exterior through pore-canals which open on the dorsal surface of the larva.

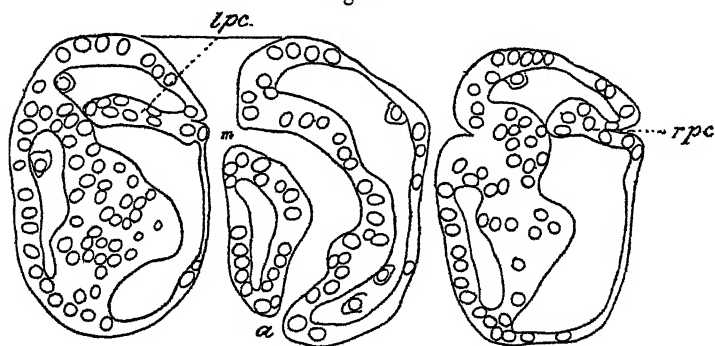
At about the time of the formation of the pore-canals or a

Fig. 3.



little before, the larval mouth breaks through on the ventral surface and there is formed the perfect bilaterally symmetrical larva shown in fig. 3, which is the optical section of a larva

Fig. 4.

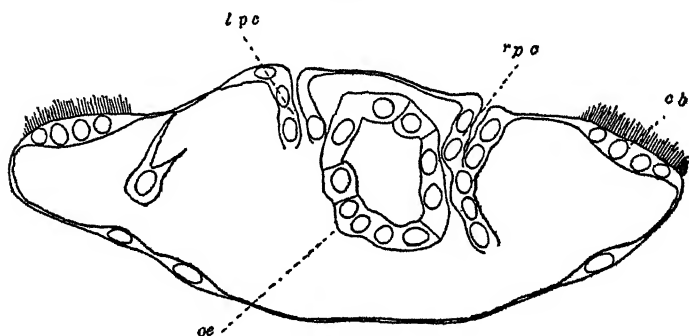


lying on its dorsal surface, the outlines having been made with a camera lucida.

The pore-canals are not, as Bury describes, intracellular

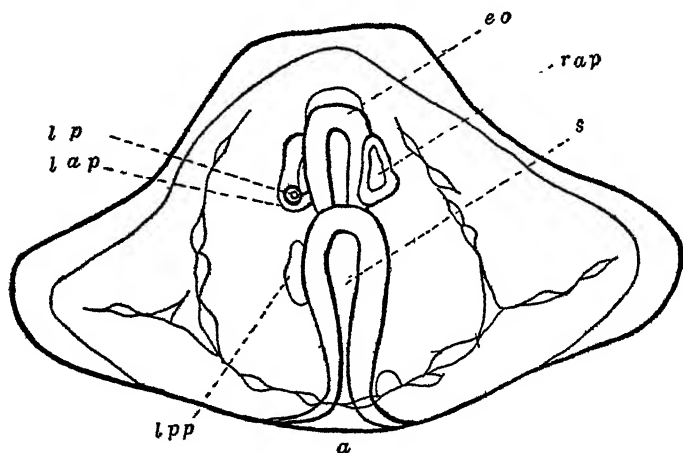
structures, but consist in an epithelium of flattened cells, as is shown by figs. 4 and 5, which are camera drawings of sections of two larvæ. Fig. 4 represents the seventeenth, twenty-first, and twenty-fourth longitudinal sections of a young larva, the seventeenth section passing through the edge of the alimentary canal and left pore-canal, the twenty-first

Fig. 5.



being the median sagittal section and passing through the mouth and anus, the twenty-fourth cutting the larva in the plane of the right pore-canal. Fig. 5 is a transverse section

Fig. 6.



through the cesophagus of a slightly older larva cutting both pore-canal openings.

The abundance of apparently normal larvæ having two pore-canals indicates that it is a normal condition of larvæ of that stage, which, should it so prove to be, would probably constitute a character of some phylogenetic importance. The right pore-canal sooner or later disappears, but persists slightly longer than the right posterior pouch, which is very transient in its character.

With the exception of the arms, which become very long, and the skeleton, which has been dissolved out, the pluteus, after undergoing the above transformation, appears as shown in fig. 6, which is the optical section of a young pluteus made in the same manner as fig. 3, but in this case the pluteus is lying on its ventral surface.

Explanation of letters in Figures.

a. Anus.
cb. Ciliated band.
iem. Inner egg-membrane.
lap. Left anterior pouch.
lpc. Left pore-canal.
lpp. Left posterior pouch.
m. Mouth.
me. Mesenchyme.

oe. Oesophagus.
oem. Outer egg-membrane.
rap. Right anterior pouch.
rpp. Right posterior pouch.
rpc. Right pore-canal.
s. Stomach.
sc. Segmentation-cavity.

LXII.—*Some apparently undescribed Insects from the Transvaal.* By W. L. DISTANT.

COLEOPTERA.

LONGICORNIA.

Fam. *Cerambycidae*.

Merionceda africana, sp. n.

Black; anterior and intermediate legs, basal non-dilated portion of posterior femora, and the elytra (excluding apical angles) ochraceous. Palpi, mandibles, and maxillæ brownish ochraceous.

The antennæ are somewhat obscurely pubescent and inwardly pilose. Head large, subquadrate, about as long as broad, coarsely punctate. Pronotum about half as long again as the head, sparingly but coarsely punctate, with a central longitudinal linear incision and a large discal foveate impression, its lateral margins slightly convex and pilose. Scutellum dull opaque black. Elytra sparingly but coarsely

punctate, the lateral margins pilose, shorter than the abdomen, broadest at humeral angles, beyond which they are distinctly emarginate, their apices narrow and subacute. Legs pilose; femora with their apical areas very strongly globose, especially those of the posterior femora, which are also coarsely punctate. Body beneath greyish pilose.

Long. 8-9 millim.

Hab. Transvaal, Lydenburg District.

I have placed this species provisionally in the Eastern genus *Merionæda*, with which it generally agrees. It will probably afford the characters for a new genus.

LEPIDOPTERA.

HETEROCEA.

Fam. Arctiadæ.

The following species of *Pusiola* has been kindly worked out and described by Sir G. F. Hampson:—

Pusiola psectriphora, Hamps., sp. n.

♂. Antennæ bipectinate, with short branches ending in a bristle; fore wing with vein 11 very faint and almost obsolete.

Orange-yellow; palpi at tips and fore tibiæ tinged with fuscous; abdomen greyish towards base. Fore wing with the inner area very slightly tinged with fuscous: hind wing rather paler orange-yellow.

Hab. Transvaal, Pretoria (*Distant*).

Exp. 36 millim.

Fam. Noctuidæ.

Eublemma plumbosa, sp. n.

Anterior wings and pronotum very pale plumbeous, greyish towards base; head, antennæ, anterior margin to pronotum, costal margin and outer marginal fringe to anterior wings, and abdomen golden yellow; posterior wings and base of abdomen pale stramineous; a small dark apical plumbeous streak at apices of anterior wings. Anterior wings beneath much darker than above; body beneath and legs golden yellow.

Exp. wings 20 millim.

Hab. Transvaal, Pretoria (*coll. Dist.*). Mashunaland, Salisbury (*Brit. Mus.*).

Fam. Hypsidæ.

Digama ostentata, sp. n.

Head, pronotum, and anterior wings plumbeous; abdomen and posterior wings stramineous. Anterior wings crossed beyond cell by a waved, narrow, macular, greyish fascia; preceding this fascia are nine small black spots more or less margined with greyish, situate four costal and basal, one above centre and two above end of cell, one in centre and one at end of cell. Anterior wings beneath paler than above, few of the spots visible; body beneath and legs pale plumbeous; sternum and abdomen with marginal rows of black spots; proboscis stramineous.

Exp. wings 35 millim.

Hab. Transvaal, Pretoria (*coll. Dist.*). Cape Colony, Annshaw (*Brit. Mus.*).

Fam. Notodontidæ.

Hoplitis gigas, sp. n.

Head, antennæ, and pronotum fuscous, lateral pronotal margins broadly greyish white; abdomen ochraceous, base narrowly, a central narrow longitudinal fascia and the apex broadly, fuscous. Body beneath and legs fuscous; lateral segmental tufts to abdomen ochraceous.

Anterior wings dull greyish, much speckled with fuscous; costal margin, two narrow outer and inner marginal fasciæ, a broader waved inner marginal fascia, and the neuration fuscous. These wings are greyish white near base and brownish grey on disk and on a subapical spot. Posterior wings greyish white, with a broad dark fuscous outer margin, which is widest at apex and somewhat obsolete at anal angle. Anterior wings beneath pale fuscous, with a streak beyond cell, an outer marginal series of spots, and a large spot near centre of inner margin greyish white. Posterior wings beneath generally as above, but with a short fuscous streak above end of cell; bases of both wings narrowly ochraceous.

Exp. wings 85 millim. Long. body 33 millim.

Hab. Transvaal, Lydenburg District.

Phalera lydenburgi, sp. n.

♀. Body above brownish ochraceous, lateral margins of the pronotum and base of abdomen greyish violaceous; apical area of abdomen banded with fuscous. Body beneath and

legs fuscous (abdomen sometimes paler), with a series of marginal dark fuscous spots.

Anterior wings with the area beneath cell greyish ochraceous, speckled with black, above cell fuscous brown; a reniform spot at end of cell, which is castaneous, margined with ochraceous; an ochraceous oblique streak extending from apex to about the region of end of cell, outwardly margined by a narrowed waved fuscous fascia; outer margin with a series of elongated conical ochraceous spots, their apices fuscous and greyish. Posterior wings pale fuscous, basal area pale ochraceous; outer fringe ochraceous, with brownish lines. Wings beneath pale fuscous, outer margins and base of posterior wings as above.

Exp. wings 50-55 millim.

Hab. Transvaal, Lydenburg District (*Pret. Mus. and coll. Dist.*).

Allied to *P. imitata*, Druce.

Cerura spiritalis, sp. n.

Head greyish ochraceous, pronotum and base of abdomen greyish white; pronotum with the anterior margin greyish ochraceous, followed by dark fuscous, posterior margin with two dark fuscous tufts; abdomen with apical two thirds dark fuscous, speckled with greyish white. Body beneath greyish white; head, antennæ, tarsi, two spots to intermediate and posterior tibiæ, and apex of abdomen dark fuscous.

Wings greyish white; anterior wings with a very small rounded spot near base, an irregular spot in cell and one above it on costal margin, three smaller subapical costal spots, an outer submarginal fascia commencing beneath apex, a large irregular spot on inner margin, and a series of small outer marginal spots dark fuscous; posterior wings with the outer margin and a small spot near end of cell fuscous. Wings beneath greyish white; both wings with a broad outer marginal fuscous fascia and an elongate spot at end of cells.

Exp. wings 53 millim.

Hab. Transvaal, Lydenburg District.

Fam. Lasiocampidæ.

Lebeda mustelina.

♂ ♀. Body and anterior wings tawny, posterior wings slightly roseate.

♂. Anterior wings with three very obscure transverse

lineate fasciæ, the two outer much waved; both wings with a distinct paler marginal fringe inwardly darkly delineated.

♀. Anterior wings with three distinct, oblique, lineate, fuscous fasciæ, about equally separated; outer marginal fringe as in male.

Exp. wings, ♂ 34, ♀ 50 millim.

Hab. Transvaal, Lydenburg District (*Pret. Mus. and coll. Dist.*).

In 1897 I described a new species of *Taragama* (*T. mirabilis*) in which, having before me then only single male and female specimens, I considered the sexes to widely diverge. I have since been able to examine a male altogether agreeing with the female described, and it is thus evident there are two distinct species.

Taragama mirabilis.

Taragama mirabilis ♂, *Dist. Ann. & Mag. Nat. Hist. ser. 6, vol. xx.* p. 208 (1897).

Transvaal, Lydenburg District (*coll. Dist.*).

Taragama cuprea, sp. n.

Taragama mirabilis ♀, *Dist. Ann. & Mag. Nat. Hist. ser. 6, vol. xx.* p. 208 (1897).

Male resembling female; posterior wings a little paler.

Exp. wings, ♂ 42 millim.

Hab. Transvaal, Lydenburg District (*Pret. Mus.*).

LXIII.—*Descriptions of some new Species of Heterocera from Tropical America, Africa, India, and the Eastern Islands.*
By HERBERT DRUCE, F.L.S. &c.

Fam. Arctiidæ.

Metaxanthia vespiformis, sp. n.

Female.—Head, antennæ, thorax, tegulæ, the basal half of the abdomen, and the legs all black; the anal half of the abdomen chrome-yellow. Primaries smoky hyaline black, darkest at the base and on the costal margin; the veins all black: secondaries whitish hyaline, dusky at the apex and round the outer margin to the anal angle; the veins black.

Expanse $1\frac{3}{10}$ inch.

Hab. Amazons, Villa Nova (*Bates, in Mus. Oxford*).

Evius sisenna, sp. n.

Female.—The front of the head yellow; antennæ, collar, tegulæ, and thorax brown; abdomen red above; the anus, underside, and legs pale yellow. Primaries reddish brown, with three pale yellow spots on the costal margin, the first nearest the base large, the second and third near the apex quite small; a yellow spot on the outer margin about the middle; the fringe yellow: secondaries red, broadly bordered with blackish brown, the fringe yellow.

Expanse 1 inch.

Hab. Brazil, Espiritu Santo (*Rogers, Mus. Oxford*).

Zatrephes (?) istria, sp. n.

Female.—Head, collar, tegulæ, thorax, abdomen, and legs red; palpi, the underside of the thorax, and abdomen white; antennæ brown. Primaries reddish brown, with three rows of reddish-yellow spots partly crossing the wing nearest the base; a wide dentated semihyaline yellow band crosses the wing beyond the cell from the costal margin to the anal angle; the outer margin yellowish red; the fringe brown: secondaries pink, semihyaline at the apex and partly along the costal margin.

Expanse $1\frac{7}{8}$ inch.

Hab. Cayenne (*Mus. Oxford*).

Sallœa unifascia, sp. n.

Female.—Head, collar, and tegulæ pale brown; thorax and abdomen above black, the sides, underside, and last three segments of the abdomen chrome-yellow; antennæ black; legs pale brown. Primaries white, crossed beyond the middle from the costal margin to the anal angle by a wide brown band, the inner margin broadly bordered with brown from the base to the anal angle: secondaries white, the inner margin broadly bordered with dark brown.

Hab. Demerara (*Mus. Oxford*).

Robinsonia flavomarginata, sp. n.

Female.—Head black, with four small white dots in front and two behind; tegulæ white, edged with black; thorax chrome-yellow; abdomen chrome-yellow on the upperside, with a black band on each side extending from the base to the anus, the underside white. Primaries brown, the costal margin broadly bordered with chrome-yellow; a wide white

streak extends from the base along the inner margin almost to the anal angle; an oval-shaped white spot at the end of the cell extending almost to the outer margin; a marginal row of white spots from the apex to the anal angle: secondaries white, the apex and outer margin clouded with blackish brown.

Expanse 2 inches.

Hab. Colombia, Bogota (*Mus. Oxford*).

Phægoptera levis, sp. n.

Female.—Head, palpi, collar, tegulæ, thorax, and basal half of the abdomen black, the anal half of the abdomen chrome-yellow, with a black spot on the middle of each segment; antennæ and legs pale brown. Primaries pale brown, dark brown at the base; three small tufts of bright chrome-yellow scales close to the base; a wide dark brown band crosses the wing almost to the inner margin; beyond the cell a second band joining the first below the cell, forming roughly a large V-shaped mark: secondaries dark brown; the fringe of both wings brown.

Expanse $2\frac{1}{4}$ inches.

Hab. South Brazil (*Rogers, Mus. Oxford*).

Fam. *Lithosiidæ*.

Nodozana xanthomela, sp. n.

Male.—Head yellow, antennæ black; thorax and tegulæ yellow; abdomen black, the anal tuft yellow; legs black. Primaries bluish black, the basal half of the wing chrome-yellow: secondaries black, the costal margin edged with yellow from the base almost to the apex.

Expanse $\frac{3}{4}$ inch.

Hab. Amazons (*Mus. Oxford*).

Talara leucocera, sp. n.

Male.—Head, antennæ, and thorax pale fawn-colour; abdomen pink; legs whitish fawn-colour. Primaries pale fawn-colour, slightly darker near the apex: secondaries pink.

Expanse $\frac{7}{10}$ inch.

Hab. Brazil, Espiritu Santo (*Rogers, Mus. Oxford*).

Cyptonychia flaviceps, sp. n.

Male.—Head, thorax, and tegulæ pale yellowish white; antennæ black; the base of the thorax and abdomen black,

the anal segment yellowish: the underside of the head, thorax, and legs black. Primaries and secondaries glossy pale yellowish white.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico (*Mus. Oxford*).

Fam. Liparidæ.

Eloria grandis, sp. n.

Female.—Head yellow, antennæ black, thorax and abdomen brownish white, legs white. Primaries and secondaries semihyaline sordid white; primaries with the costal margin edged with brown, the apex broadly blackish brown.

Expanse 3 inches.

Hab. Amazons (*Mus. Druce*).

This is the largest species in the genus.

Eloria mæonia, sp. n.

Female.—Head, palpi, thorax, and tegulæ yellow; antennæ black; abdomen greyish white, yellowish on the underside; the legs black. Primaries and secondaries pale greyish white, the veins all pale brown; the base of the primaries pale yellow, the apex and part of the costal margin dusky.

Expanse $2\frac{1}{4}$ inches.

Hab. Guiana (*Mus. Druce*).

Xenosoma (?) *lasea*, sp. n.

Female.—Head, antennæ, thorax, and abdomen black, the collar and each segment of the abdomen edged with pale yellow; a yellow line on each side of the abdomen; legs black. Primaries white from the base to about the middle, then semihyaline black, the veins all black: secondaries white, slightly dusky hyaline at the apex.

Expanse 2 inches.

Hab. W. Africa, Sierra Leone (*Mus. Druce*).

Aza eutelida, sp. n.

Male.—Head, antennæ, and thorax pale brown; abdomen white; legs yellow. Primaries white, the costal and outer margin edged with yellowish brown: secondaries white.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

Cypra (?) *Forbesi*, sp. n.

Male.—Head, thorax, tegulæ, abdomen, and legs pale yellow; antennæ black. Primaries semihyaline white, yellowish at the base and partly along the costal margin, which is edged with black: secondaries semihyaline white.

Expanse 2 inches.

Hab. New Guinea (*Forbes*); Fergusson Island (*Meek*, *Mus. Druce*).

Antiphella vecontia, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs pale yellow. Primaries and secondaries semihyaline yellowish white: primaries, the costal margin edged with yellow, the veins pale yellow; the fringes of both wings glossy yellowish white.

Expanse $1\frac{3}{4}$ inch.

Hab. South Africa, Orange River (*Mus. Druce*).

Antiphella telesilla, sp. n.

Male.—Head, thorax, and abdomen brownish white; antennæ and legs pale brown. Primaries and secondaries semihyaline white: primaries slightly shaded with yellow at the base, along the costal and outer margin; two small black dots at the end of the cell; the fringe yellowish white.

Expanse 2 inches.

Hab. East Africa, Zanzibar (*Mus. Druce*).

Euproctis (?) *mirma*, sp. n.

Male.—Head, thorax, and tegulæ dark brown; abdomen paler brown; antennæ reddish brown; legs brown. Primaries pale brownish fawn-colour; a small spot at the base, one at the end of the cell, and two curved lines crossing the wing from the costal to the inner margin, all black: secondaries uniformly pale yellowish white.

Expanse $1\frac{1}{2}$ inch.

Hab. Timor (*Forbes*, *Mus. Druce*).

Euproctis titania, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs pale yellow. Primaries and secondaries pale yellow, the primaries crossed from the costal to the inner margin by three

waved chrome-yellow bands.—*Female* similar to the male, but darker in colour and without the bands on the primaries.

Expanse, ♂ 1, ♀ $1\frac{4}{10}$ inch.

Hab. Trobriand Island, Kiriwini (*Meek, Mus. Druce*).

Artaxa faventia, sp. n.

Male.—Head, antennæ, thorax, tegulæ, and legs dark brown; abdomen black, the anal tuft white. Primaries uniformly dark brown: secondaries bright chrome-yellow, the base broadly black: the underside very similar to the upperside.

Expanse $1\frac{3}{4}$ inch.

Hab. Fergusson Island (*Meek, Mus. Druce*).

Pantana eurygania, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs black. Primaries black; a white spot at the end of the cell and a large white spot below the cell extending to the inner margin: secondaries white, the base blackish, the outer margin broadly bordered with black from the apex almost to the anal angle.

Expanse $1\frac{1}{4}$ inch.

Hab. Western China (*Mus. Druce*).

Rhanidophora agrippa, sp. n.

Male.—Head, thorax, tegulæ, and abdomen yellow; palpi and antennæ black; legs black. Primaries fawn-colour, with three large round yellow spots edged with black, the first in the middle of the cell, the second and third at the end of the cell one above the other; the base and inner margin of the wing streaked with yellow: secondaries chrome-yellow, broadly bordered from the apex almost to the anal angle with greyish fawn-colour; the fringe chrome-yellow.

Expanse $1\frac{3}{4}$ inch.

Hab. East Africa (*Mus. Druce*).

This species is closely allied to *R. phedonia*, Cram.

Dasychira viridis, sp. n.

Male.—Head, thorax, and tegulæ brownish green; antennæ and palpi dark brown; abdomen and legs brown; the anus pale brown. Primaries brown, thickly crossed from the costal to the inner margin with pale green fine waved lines; the

costal margin partly edged with white: secondaries uniformly pale brown; the undersides of both wings pale brown.

Expanse $1\frac{3}{4}$ inch.

Hab. Perak, 2000–3500 feet (*Doherty, Mus. Druce*).

Fam. *Lasiocampidæ*.

Odonestis Lidderdali, sp. n.

Male.—Head, palpi, antennæ, thorax, tegulæ, abdomen, and legs dark brown. Primaries dark brown, irrorated with greyish scales and crossed from the costal to the inner margin by very faint waved brown lines: secondaries very dark brown, the fringe reddish brown on the outer margin.

Expanse 2 inches.

Hab. Darjeeling (*Lidderdale, Mus. Druce*).

Odonestis Pryeri, sp. n.

Male.—Head, collar, thorax, and tegulæ dark red-brown; antennæ black; abdomen pale brown; legs reddish brown. Primaries dark red-brown, crossed from the apex to the inner margin close to the base by a dark red-brown line: secondaries the same colour as the primaries, but rather paler.

Expanse $1\frac{3}{4}$ inch.

Hab. China, Hong Kong (*Pryer, Mus. Druce*).

Megalopyge mallas, sp. n.

Male.—Head, thorax, tegulæ, abdomen, and legs black-brown; antennæ brownish white. Primaries pale brown, the costal margin from the base to the apex broadly white; a white line crosses the wing beyond the middle from the costal to the inner margin: secondaries pale brown.

Expanse $1\frac{1}{2}$ inch.

Hab. South-east Brazil, Rio Janeiro (*Mus. Druce*).

Hydrias cloe, sp. n.

Male.—Head, antennæ, collar, tegulæ, thorax, abdomen, and legs pale fawn-colour. Primaries pale fawn-colour, crossed beyond the middle by a very fine white curved line extending from the costal to the inner margin; a marginal row of small white spots from the apex to the anal angle, the last two brown: secondaries pale fawn-colour, with a marginal row of six semihyaline white spots, the first two small, the third large, and the last three about equal size.

Expanse $1\frac{1}{10}$ inch.

Hab. Brazil, São Paulo (*Mus. Druce*).

Hydrias vocontia, sp. n.

Male.—Head, antennæ, thorax, collar, tegulæ, abdomen, and legs pale fawn-colour. Primaries pale fawn-colour, crossed from the costal to the inner margin by five waved paler fawn-coloured lines; the veins and a small spot at the end of the cell white; two black spots on the apex and a darker brown line close to the anal angle; the marginal line white, edged with black; the fringe fawn-colour: secondaries fawn-colour, the marginal line and the end of the veins white, the fringe fawn-colour.

Expanse $1\frac{1}{2}$ inch.

Hab. Bolivia (*Garlepp, Mus. Druce*).

Hydrias gibeæ, sp. n.

Male.—Head, antennæ, and collar dark grey, almost black; thorax, abdomen, and legs greyish white. Primaries grey, irrorated with black scales, the costal, apex, and outer margin edged with pink; a black spot at the end of the cell, from which a pink line extends to the outer margin: secondaries, the costal half of the wing grey, with pink margin, the inner half pale brown.

Expanse $2\frac{7}{10}$ inches.

Hab. Venezuela (*Mus. Druce*).

Hydrias rages, sp. n.

Female.—Head, antennæ, and front of the thorax pale fawn-colour; thorax grey; abdomen and legs fawn-colour. Primaries fawn-colour, irrorated with white scales and crossed from the costal to the inner margin by three very indistinct grey bands: secondaries pale brown, greyish at the apex and round the outer margin.

Expanse $1\frac{3}{4}$ inch.

Hab. Amazons (*Leech, Mus. Druce*).

Hydrias pira, sp. n.

Female.—Head, antennæ, thorax, tegulæ, abdomen, and legs reddish fawn-colour. Primaries dark reddish fawn-colour, crossed from the costal to the inner margin by three brownish-white zigzag lines (the first close to the base, the second beyond the cell very indistinct, the third submarginal), with some spots close to the apex; a brown streak extends from the base to the end of the cell; the fringe alternately fawn-colour and grey: secondaries reddish fawn-colour, with

three brownish lines partly crossing the wing close to the apex.

Expanse 2 inches.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

Hydrias ozora, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs pale brown. Primaries pale brown, darkest at the base and partly along the costal margin; a marginal row of dark brown spots edged with white extends from the apex to the anal angle: secondaries pinkish fawn-colour, shaded with brown along the costal margin.

Expanse $1\frac{3}{4}$ inch.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

Plegapteryx titia, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs dark reddish brown. Primaries and secondaries dark reddish brown, palest on the outer margins of both wings; a round black spot at the end of the cell and a greenish-brown spot in the cell; both wings with a narrow black line extending from the apex to the anal angle: underside bright reddish yellow, with the spots and lines more distinct than on the upperside.

Expanse $1\frac{3}{4}$ inch.

Hab. West Africa, Calabar (*Mus. Druce*).

Taragama choba, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs very dark blackish brown, almost black. Primaries dark reddish brown; two white spots on the costal margin and a white streak at the end of the cell: secondaries dark blackish brown.

Expanse $1\frac{3}{10}$ inch.

Hab. W. Africa, Lagos (*Sir Alfred Moloney, Mus. Druce*).

Taragama nicha, sp. n.

Female.—Head, thorax, tegulæ, and legs reddish fawn-colour; antennæ black. Primaries pale greyish fawn-colour, slightly reddish at the base, the apex irrorated with black scales: secondaries reddish fawn-colour, the outer margin edged with black and grey spots.

Expanse $1\frac{3}{4}$ inch.

Hab. S. Africa, Caffraria (*Mus. Druce*).

Fam. Limacodidæ.

Paryphanta lacides, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs pale cream-colour. Primaries pale cream-colour, crossed from the costal to the inner margin by a number of fine reddish-brown lines, those at the end of the cell being the most distinct: secondaries the same colour as the primaries, but rather darker and without any markings.—*Female* almost identical with the male, but slightly darker and larger in size.

Expanse 1 inch.

Hab. E. Africa, Dar-es-Salem (*Mus. Druce*).

Narosa flaccidia, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs dark brown. Primaries pale brown, from the base to the middle very dark brown, edged with a whitish-brown line beyond; a zigzag pale greyish line extends from the costal to the inner margin; a marginal row of minute brown spots from the apex to the anal angle: secondaries pale grey-brown.

Expanse 1 inch.

Hab. E. Africa, Dar-es-Salem (*Mus. Druce*).

Miresa binea, sp. n.

Male.—Head, antennæ, thorax, tegulæ, abdomen, and legs pale fawn-colour. Primaries and secondaries pale fawn-colour; primaries crossed from the apex to the inner margin close to the base with a fine brown line; a curved brown line extends from the apex to the anal angle; a dark brown spot at the end of the cell: secondaries, the outer margin spotted with black.

Expanse $1\frac{1}{4}$ inch.

Hab. New Guinea, Port Moresby (*Goldie, Mus. Druce*).

Miresa aquila, sp. n.

Male.—Head, antennæ, thorax, and tegulæ brown; abdomen and legs fawn-colour. Primaries brownish fawn-colour; a pale fawn-coloured band crosses the wing from the costal margin to the anal angle, the outer side edged with black, the apex darker brown, the fringe alternately dark brown and fawn-colour: secondaries pale reddish fawn-colour.

Expanse 1 inch.

Hab. New Guinea, Port Moresby (*Goldie, Mus. Druce*).

LXIV.—Notes on a Collection of Gryllidæ, Stenopelmatidæ, Gryllacridæ, and Hetrodidæ formed by Mr. W. L. Distant in the Transvaal and other South- and East-African Localities. By W. F. KIRBY, F.L.S., F.E.S., &c.

THE following list is preliminary to Mr. Distant's comprehensive work on the Insects of the Transvaal, now in course of preparation, and may be followed from time to time by other lists of a similar character.

Two new species of Stenopelmatidæ are provisionally referred to *Carcinopsis*; but they differ somewhat in the structure of the head, and it is probable that many species of the family remain to be discovered, which may necessitate a revision of the generic characters.

ORTHOPTERA.

Gryllidæ.

Gryllotalpinæ.

Curtilla, Oken.
africana, Beauv.

Gryllinæ.

Brachytrypes, Serv.
membranaceus, Dru.
Acheta, Linn.
bimaculata, De Geer.
Gryllus, Linn.
domesticus, Linn.
burdigalensis, Latr.
posticus, Walk.
ignobilis, Walk.
melanocephalus, Serv., var.
Cophogryllus, Sauss.
Delalandii, Sauss.
Scapsipedus, Sauss.
marginatus, Afz. & Brann.

Enopterinæ.

Anandus, Sauss.
nigrosignatus, Stål.

Stenopelmatidæ.

Carcinopsis, Brunn.
vittata, sp. n.
punctulata, sp. n.
Nasidius, Stål.
truncatifrons, Stål.

Gryllacridæ.

Gryllacris, Serv.
lyrata, n. n.
(= *aliena*, Brunn.)

Hetrodidæ.

Acanthophus, Stål.
discoidalis, Walk.
Enyalipsis, Karsch.
Petersii, Schaum.
Acanthoproctus, Karsch.
Howarthæ, Kirby.

Gryllidæ.

Gryllotalpinæ.

Curtilla africana.

Gryllotalpa africana, Pal. de Beauv. Ins. Afr. Amér. p. 229, Orth. pl. xx. c. fig. 6 (1805?).

4, Pretoria (*Distant*); 1, Barberton (*Rendall*); 3 (immature), Fort Johnston, Nyasaland (*Rendall*).

A common species throughout the warmer parts of the Old World.

Gryllinæ.

Brachytrypes membranaceus.

Gryllus membranaceus, Dru. Ill. Ex. Ent. ii. pl. xliii. fig. 2 (1773).

3, Fort Johnston, Nyasaland (*P. Rendall*); 1, Barberton (*Rendall*); 1, Delagoa Bay (*Junod*).

A common and widely distributed African species.

Acheta bimaculata.

Gryllus bimaculatus, De Geer, Mém. Ins. iv. p. 521. n. 4, pl. xliii. fig. 4 (1773).

7, Pretoria (*Distant*); 2, Nyasaland (*Rendall*); 3, Barberton (*Rendall*); and 1 without locality.

One or two of these specimens are immature.

A common species throughout the warmer parts of the Old World.

Gryllus domesticus.

Gryllus domesticus, Linn. Syst. Nat. (ed. x.) i. p. 423. n. 20 (1758).

6, Fort Johnston, Nyasaland (*Rendall*).

Our familiar house-cricket; a cosmopolitan species at the present day.

Gryllus burdigalensis.

Gryllus burdigalensis, Latr. Hist. Nat. Crust. Ins. xii. p. 124. n. 3 (1804); Sauss. Mém. Soc. Gèneve, xxv. (1) p. 185 (1875).

4 ♀, Pretoria (*Distant*).

A variable and widely distributed species in the Mediterranean region, Asia, and Africa. There are also two immature specimens from Pretoria which probably belong to the same species.

Gryllus posticus.

Gryllus posticus, Walk. Cat. Derm. Salt. i. p. 30. n. 50 (1839).

Gryllus leucostomus, Sauss. Mém. Soc. Gèneve, xxv. p. 167 (1877).

Fort Johnston, Nyasaland (*Rendall*).

I think De Saussure is mistaken in referring this species to *G. leucostomus*, Serv., and therefore prefer to adopt Walker's name for it.

Gryllus ignobilis.

Gryllus ignobilis, Walk. Cat. Derm. Salt. i. p. 29. n. 47 (1869).

1, Fort Johnston, Nyasaland (*Rendall*); 1, Barberton (*Rendall*).

Originally described from Natal. *G. ignobilis*, Sauss., from Java and Amboina, will require renaming.

Gryllus melanocephalus, var.

Gryllus melanocephalus, Serv. Ins. Orth. p. 342 (1839).

2, Nyasaland (*P. Rendall*).

A variable species, inhabiting Africa and the East Indies.

Cophogryllus Delalandii, var. (?).

Cophogryllus Delalandii, Sauss. Mém. Soc. Gèneve, xxv. p. 234, pl. xiii. (13) fig. 2 (1877).

1, Brak Kloof, near Grahamstown.

Closely resembles Saussure's description and figure, but has six testaceous lines on the vertex, the two outer ones on each side meeting at the eyes. There is a black arch between the antennæ over a testaceous space, separated from the black vertex by a narrower testaceous arch.

Scapsipedus marginatus.

Acheta marginata, Afzel. & Brann. Achet. Guin. p. 23. n. 4, fig. 5a (1804).

Scapsipedus marginatus, Sauss. Mém. Soc. Gèneve, xxv. p. 243 (1876).

Gryllus parallelus, Walk. Cat. Derm. Salt. i. p. 32. n. 53 (1869).

Gryllus diadematus, Gerst. Von der Decken's Reisen, iii. (2) p. 25. n. 37 (1873).

8, Pretoria (*Distant*).

A species inhabiting both East and West Africa.

E NEOPTERINÆ.

Anandus nigrosignatus.

Rupilius nigrosignatus, Stål, Cefv. Vet.-Akad. Förh. 1876, (3) p. 66.

Anandus nigrosignatus, Sauss. Mém. Soc. Gèneve, xxv. p. 654 (1878).

1, Rustenburg (*Krantz*).

The markings of this species are not unlike those in Saussure's figure of his *Tapinopus platyceps*, from New Caledonia.

Stenopelmaticidæ.*Carcinopsis vittata.*

Long. corp. 31-40 millim.; pronoti 9-10 millim.; fem. post. 17 millim.; tib. post. 23-26 millim.; ovip. 15-19 millim.

Female.—Chestnut-brown, face varied with yellow; fastigium of the vertex with a yellow spot on each side opposite the base of the antennæ, and two more at the extremity, which is depressed, convergent, and truncated, separated from the fastigium of the front by a slight suture; the middle and sides of the face, as well as the antennæ, palpi, and legs, are mostly yellowish.

Pronotum with the deflexed lobes having the angles rounded off and the lower border nearly straight. Abdomen with a broad transverse black band occupying the hinder part of each segment.

All the femora unarmed; front tibiæ with a middle and terminal spine on the inner side above, but only the terminal spine on the outer side; beneath, with a row of 5 strong spines on each side. Middle tibiæ with 4 spines above on the outside and 3 on the inside; beneath, with 5 spines on each side. Hind tibiæ with a row of 7 spines on each side above in addition to the terminal spines; beneath, with 3 slender spines before the terminal spines. Most of the spines are very strong and tipped with black. The spines on the four hind coxæ are also strongly marked. Hind femora much thickened; ovipositor long, slender, upcurved.

Two specimens from Barberton (*P. Rendall*).

Described from the larger specimen; the smaller one is considerably paler in colour, inclining to reddish or yellowish rather than reddish brown.

Probably allied to *C. ornata*, Brunn., from Madagascar; but that species is banded with black on the thorax and the tibial spines are much smaller, as represented in the figure.

Carcinopsis punctulata.

Long. corp. 29 millim.; pronoti 7-9 millim.; fem. post. 18-20 millim.; tib. 15-18 millim.; ovip. 10-15 millim.

Female.—Head, pronotum, and femora rufo-castaneous, rest of legs and ovipositor darker, hind border of pronotum and abdomen æneous brown.

Head above and pronotum nearly smooth; fastigium of the vertex transversely wrinkled below, passing into the fastigium of the front without interruption. Face thickly punctured and blackish in the middle; cheeks reddish, with

two strong converging carinæ; mouth-parts and tips of mandibles mostly black. Pronotum with the angles of the deflexed lobes rounded off, the lower edge nearly straight.

Abdomen thickly and closely punctured, especially on the terminal segments.

Femora unarmed; front tibiæ with 2 spines above on the inner side and with only the terminal one on the outer; beneath, with 5 pairs of spines; middle tibiæ with 3 or 4 spines on each side above and 6 pairs below (inclusive of the terminal ones); hind tibiæ with 7 spines on the outside and 8 on the inside (exclusive of the terminal spines); hind femora considerably thickened and very deeply longitudinally sulcated on the outer side.

1, near Eureka, Barberton (*P. Rendall*), type; 1, Zoutpansberg (*Kæssner*).

As usual, the larger specimen, which is here described, is darker-coloured than the other.

This species may be allied to *C. femoralis* and *C. fusca*, Brunn., but nothing is said of their being punctuated.

Nasidius truncatifrons.

Nasidius truncatifrons, Stål.

2, Barberton (*Rendall*); 1, Zomba, Nyasaland (*Rendall*).

Gryllacridæ.

Gryllacris lyrata, n. n.

Gryllacris aliena, Brunner (nec Walker), Verh. zool.-bot. Ges. Wien, xxxviii. p. 338 (1888).

1, Pretoria (*Distant*); 3 (immature), Barberton (*P. Rendall*).

As this species requires renaming, I have taken the present opportunity of doing so. It was described by Brunner from Zanzibar, and the Natural History Museum possesses a pair from Machuma, Taru Desert, British East Africa, collected by Mr. C. S. Betton.

Hetrodidæ.

Acanthoplus discoidalis.

Hetrodes discoidalis, Walk. Cat. Derm. Salt. B. M. ii. p. 230. n. 18 (1869).

1, Pretoria (*Distant*); 1, Zoutpansberg (*Kæssner*).

These specimens agree with the paler specimen described

by Walker, except that they are of a reddish brown, reddish on the thorax. The abdomen has a row of spines pointing backwards on the median line and three rows of large black oblong spots on the back and sides; the median row macular, the lateral rows partly connected behind, and each marked rather behind its centre with a large reddish dot. On the basal segments the black markings are more or less connected at the base of the segments.

Enyaliopsis Petersii.

Heterodes Petersii, Schaum, Ber. Ver. Akad. Berl. 1853, p. 777; Peters's Reise Mossamb. v. p. 119, pl. vii. fig. 7 (1862).

1, Pretoria (*Distant*); 3, Barberton (*Rendall*); 2, Fort Johnston, Nyasaland (*Rendall*); 1, Angola (*Monteiro*).

The frontal horn in some of these specimens is shorter and broader than usual. There are two immature specimens among them.

Acanthoproctus Howarthæ.

Acanthoproctus Howarthæ, Kirb. Ann. & Mag. Nat. Hist. (7) iii. pp. 101, 145 (1899).

1, Brak Kloof, near Grahamstown.

The types were received from E. Karoo, Cape Colony.

LXV.—*On one little-known and one hitherto unknown Species of Saurocephalus.* By O. P. HAY*.

THE fish *Saurocephalus lanciformis* was first described and named by Dr. Richard Harlan in 1824†. This description and the accompanying figures were reprinted in 1835 in the same author's 'Medical and Physical Researches'‡. The specimen on which the genus and species were based had been collected about twenty years previously, by Lewis and Clark, at some locality probably in North-eastern Nebraska. It consisted of the greater portion of the left maxilla; but was described by Harlan as belonging to the lower jaw. He also regarded it as having belonged to a reptile allied to *Ichthyosaurus*. Louis Agassiz first recognized the ichthyic

* From the 'American Journal of Science,' April 1899, pp. 299-304.

† Journ. Acad. Nat. Sci. Philad. (1) iii. pp. 331-337, pl. xii. figs. 1-5.

‡ Med. Phys. Res. pp. 362-366, pl., figs. 1-5.

nature of the remains* (although he confounded them with an entirely distinct species); and his conclusions were confirmed by Richard Owen †. Dr. Leidy ‡ corrected Agassiz's errors, and gave more accurate descriptions and figures of the maxillary than had been furnished by Harlan.

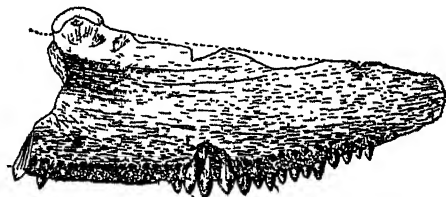
No remains of Harlan's species, other than the maxillary referred to, have hitherto been described. Dr. E. W. Hilgard § has reported the species as occurring in the Vicksburg group of the Eocene, but the identification was undoubtedly erroneous. Dr. William Spillman || has also included this species in his list of fossils belonging to the Tombigbee greensand of the Cretaceous at Columbus, Miss. Although this identification is less improbable than the former, we have nothing to confirm its correctness.

Notwithstanding the scantiness of the material belonging to the type species, our knowledge of the genus *Saurocephalus* has been greatly increased through the descriptions of closely related and more perfectly preserved species. For this additional knowledge we are indebted to Cope and Newton, and more recently to Alban Stewart, of the University of Kansas.

For some time I have had in my possession some remains which on examination prove, in my judgment, to belong to Harlan's species. This material was collected for me in the region of Butte Creek cañon, south of Wallace, Kan.; and the horizon is undoubtedly that of the Niobrara Cretaceous. My material consists of both the mandibles, the right maxilla, the pterygo-palatine arch, and a few other bones.

The maxillary (fig. 1) is rather short and deep. The

Fig. 1.



× $\frac{5}{8}$.

portion belonging in front of the palatine condyle is missing; but the condyle itself is present. The alveolar border is

* Poiss. Foss. v. p. 102.

† Odontography, p. 130, pl. 55.

‡ Trans. Amer. Philos. Soc. 1857, xi. pp. 91-95, pl. vi. figs. 8-11.

§ Report Geol. & Agric. Mississippi, 1860, p. 142.

|| Op. cit. p. 389.

somewhat curved, and is occupied by compressed sharp-edged teeth. Of these there are present twenty-eight; but if we restore the bone, as we can safely do, I believe, by aid of Stewart's figures of *S. dentatus**, we may conclude that there were originally thirty-four teeth, possibly one or two less. The root of the most anterior tooth has been exposed by the fracture, and its fang is seen to be distinctly faceted; so that it presents just such an appearance as the tooth of *S. lanciformis* figured by Leidy†. The roots of teeth situated more posteriorly, whose fangs have been exposed by a tool, are similarly faceted. Cope states‡ that *S. lanciformis* is to be distinguished from his *S. arapahovius* by the lack of facets on the roots of the teeth of the latter.

Leidy estimated that the maxilla in his hands had supported only twenty-six or twenty-eight teeth, and he was probably correct. That maxilla, a larger one than the one in my possession, seems to have been broken just behind the palatine condyle. If now we take from Leidy's drawing the width of the bone at this point and apply it to the alveolar border, we find that it includes ten teeth; the width of my own specimen includes thirteen teeth. It is not impossible, however, that the specimen figured by Leidy had been broken away some little distance behind the condyle. At any rate, I do not believe that the difference of a few teeth, other things being alike, would justify us in regarding the specimens as belonging to different species.

As in the case of the original specimen, there is a shallow groove running along the mesial surface of the maxilla, about 5 millim. from the alveolar border, and from this groove foramina, one for each tooth, enter the bone.

	millim.
Depth of maxillary at palatine condyle	38
Distance from anterior end of palatine condyle to hinder end of maxillary	85

The right mandible is shown in fig. 2, five eighths the natural size and showing the mesial surface. The alveolar border is straight and supports thirty-four teeth, of which those occupying the middle of the border are the largest. In general, they are larger than the teeth of the upper jaw. The line which spans thirteen teeth in the maxilla spans ten in the dentary. At the proximal end of the mandible there must have been a process of the dermarticulare, as in related

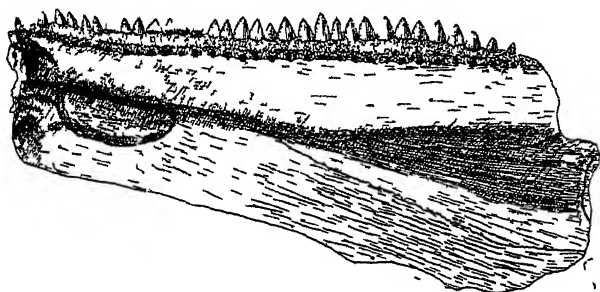
* Kan. Univ. Quart. vii. p. 25, pl. i. figs. 3a, 4a.

† Trans. Amer. Philos. Soc. xi. pl. vi. fig. 9.

‡ Cretaceous Vertebrata, p. 216.

forms; but in the specimen figured it is hidden by the overlying ceratohyal, which is not shown in the figure. At the anterior end of the mesial face of the dentary there is found a broad surface, rough with processes and pits, an indication that the two dentaries were strongly bound together. The

Fig. 2



extreme anterior end of each dentary is occupied by a surface to which was evidently attached such a predentary as Stewart has described as belonging to several related species. A groove and a row of foramina are present on the median face of the dentary.

	millm.
Length of alveolar border	112
Length of mandible from cotylus	130
Depth of mandible at last tooth	56
Depth of mandible at symphysis	34

Fig. 3 represents, five eighths the natural size, the pterygo-

Fig. 3.

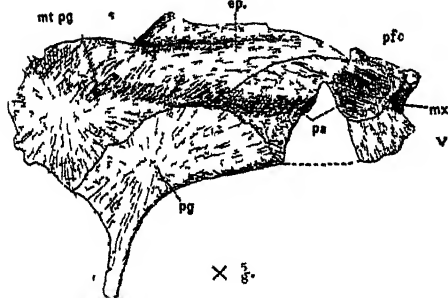


Fig. 4.



$\times \frac{1}{2}$.

palatine arch seen from within. A triangular piece is missing from the anterior end, and the lower end of the

ectopterygoid, *pg*, is defective. As I interpret the bones, the arch is remarkable for the large size of the palatine, *pa*. While the sutures which are represented in the figure are very distinct, I am wholly unable to find one separating the entopterygoid, *ep*, from the metapterygoid, *mt.pg*. On the upper border of the arch, at the point indicated by the line *s*, there appears to be an indication of a suture. If such it is, it probably extends downwards to a point near the hinder end of the palatine. The arrangement of the bones is quite different from that found by myself in *Xiphactinus* *.

At the lower border of the anterior end of the palatine there is a broad surface, *v*, which was probably in contact with an articulating surface on the vomer. The notch seen in the anterior end is occupied by another articulatory surface, *mx*, for the anterior palatine condyle of the maxilla. The anterior end of the upper border furnished an articulation, *pfc*, with the prefrontal, but this is elongated and rough, not broad and smooth, as it is in *Xiphactinus*.

Anteriorly the palatine is thick and strong. On its outer surface this portion is finely vermiculated above, while the lower portion furnishes a concave articulation for the condyle of the maxilla. The general appearance of this portion may be seen from fig. 4, which represents the palatine of the next species. Below the concave surface for the palatine condyle of the maxilla there is seen a broad rough surface which must have been applied to the inner face of the maxilla. The greater portion of this is wanting in the specimen shown in fig. 4. Its limits are indicated by the dotted line. On the outer face of the metapterygoid, from the highest point seen in fig. 3 there runs downward and backward a sharp ridge which evidently bounded the orbit below. The portion of the metapterygoid above and mesiad of this ridge formed the floor of the orbit. This indicates that the orbit was placed well backward. I find no satisfactory evidences of the presence of teeth on the pterygoid and palatine bones. If we add to the maxillary the probable antero-posterior extent of the premaxillary, we shall find that it is approximately equal to the length of the lower jaw. Hence the latter did not project beyond the upper jaw as it did in the case of those species which Stewart has referred to the genus *Saurodon*.

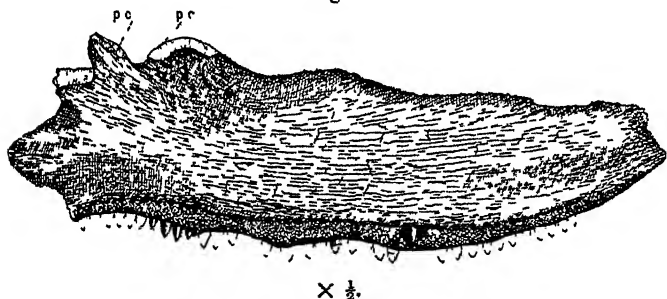
Two characters seem to distinguish *Saurodon* from *Saurocephalus*, viz.: the presence of notches, instead of foramina, for the successional teeth and the projection of the lower

* Zoolog. Bull. ii. 1898, p. 39, fig. 7.

jaw beyond the snout of the fish. I have been inclined to believe that the presence of these two characters is sufficient to distinguish *Saurodon* as distinct. However, I observe in some specimens of this supposed genus that some of the notches become closed into foramina; and we can easily imagine all gradations between notches and foramina high above the alveolar margin. Moreover, it is probable that the other character will fail. Recently Mr. Stewart* has published figures, without description, of remains which he refers to Cope's *Saurodon phlebotomus*. Mandible and maxilla are shown. Measurements show that the maxilla, without the premaxillary, is nearly as long as the alveolar border of the mandible, so that it is almost certain that in this species there was no projection of the dentary beyond the snout. It seems probable, therefore, that *Saurodon* must be abandoned.

I present here (fig. 5) the right maxilla and the premaxillary (fig. 4) of another species of *Saurocephalus*, which I regard as yet undescribed. It is especially distinguished from described species by its elongated maxillary bone. To

Fig. 5.



illustrate this, I compare it with Mr. Stewart's *S. dentatus*, which is itself a species with a rather long maxilla. In *S. dentatus* the total length of the maxilla is 142 millim., its height at the palatine condyle 48.5 millim. My specimen has the same height at the condyle; but the total length is 172 millim., a difference of 30 millim., equal to 21 per cent. of the shorter maxilla. My species, therefore, probably had a relatively slender head and a larger mouth than had *S. dentatus*.

In the maxilla figured I count alveoli for thirty-seven teeth; but in the maxilla of the other side, somewhat broken,

* Kan. Univ. Quart. vii. pl. xvi. figs. 4, 5.

the teeth extend backward somewhat farther, so that there must have been forty. At some time in the career of its owner the right maxilla has been fractured obliquely across its middle, and this accident has affected the neighbouring teeth. One of these has thus become exposed nearly half-way to the tip of the fang. This exposure reveals the fact that the fang is faceted, as it is in *S. lanciformis*. The great length of the maxilla distinguishes this species from both *S. lanciformis* and *S. dentatus*, and the facets on the teeth distinguish it from Cope's *S. arapahovius*. Mr. Stewart has not described the condition of the fang of the teeth of his *S. dentatus*.

In fig. 5 *p.c.* represents the palatine condyle; *p.c.*' the anterior palatine condyle which was applied to a surface like that shown in fig. 3 at *mx*.

I propose to call the fish above described *Saurocephalus pamphagus**.

It has been supposed that the foramina, situated one opposite each tooth and on the mesial face of the maxilla and of the dentary, are for the transmission of nerves and vessels to the teeth. Richard Owen† seems not to have so regarded these foramina. He believed that they "lead to the cavities containing the germs of the successional teeth." The latter probably began their development in, or at the bottom of, these foramina; but they soon passed more deeply into the bone. In fig. 1 at *t* there is found a developing tooth whose tip is on a level with the row of foramina; but its root extends high up into the bone. Nerves and vessels entering the tooth by way of the foramina alluded to would have to take a very tortuous course. The functional tooth immediately below the young tooth figured seems already to have suffered some reduction of its fang.

The germs of the teeth of the Saurocephalidæ did not gain a lodgment in the bones of the jaws in the same way that the teeth of the higher vertebrates did. In the latter the fangs were first planted in grooves in the dental borders of the bones; and we must suppose that these grooves, at first shallow, have, in successive generations, deepened and become portioned off to form sockets. In the Saurocephalidæ the teeth, developing originally on the dental border, have gradually migrated away from this border, on the mesial face of the supporting bones, and, by means of the foramina described above, have made their way through the mesial wall

* Inde ruunt alii rapida velocius aura,

Pamphagus et . . .

Ovid, *Met.* Bk. iii. l. 200.

† Odontography, p. 131.

of the sockets. The notches found in the species referred to *Saurodon* show the earliest stages of this migration.

The distinguished palæo-ichthyologist, Mr. A. S. Woodward, has recently kindly called my attention to a suggestion made by Prof. E. D. Cope that the Saurocephalidæ are closely related to the Chirocentridæ, represented by the large *Chirocentrus dorab* of the Chinese and Indian seas. I have unfortunately had no opportunity to study a skeleton of this fish; but, judging from the figures of the fish found in Cuvier and Valenciennes, pl. 565, and in Day's 'Fishes of India,' pl. clxvi. fig. 3, its external appearance must be much like that of the extinct *Xiphactinus*. Nevertheless, we have no intimations that the teeth of *Chirocentrus* are fixed to the jaws in any way different from those of ordinary fishes. The fixation of the teeth in sockets is an unusual thing among fishes; and this character alone, it appears to me, is sufficient to remove *Xiphactinus* and its allies from the Chirocentridæ, although not necessarily to a great distance. I suspect that the Saurocephalidæ will, when they are better known, show distinctive characters in the vertebral column also.

LXVI.—*Note on Scapanorhynchus, a Cretaceous Shark apparently surviving in Japanese Seas.* By A. SMITH WOODWARD, F.L.S.

IN his paper on the Cretaceous fishes from Mount Lebanon published twelve years ago *, the late James W. Davis gave an unsatisfactory description and figure of a remarkable new shark under the preoccupied generic name of *Rhinognathus*. He pointed out some of its principal characters, and, notwithstanding the demonstrated presence of an anal fin, placed the fish in the family Spinacidæ. In 1889 †, after a detailed study of the fine series of specimens in the British Museum, the present writer published an amended definition of the genus under the new name of *Scapanorhynchus*, placing it in the family Lamnidæ close to the well-known existing genus *Odontaspis*. The dentition was shown to be identical with that of the latter genus; but other characters, such as the slenderness of the fish, the peculiar elongation of the rostrum,

* J. W. Davis, "On the Fossil Fishes of the Chalk of Mount Lebanon, in Syria," Trans. Roy. Dublin Soc. [2] vol. iii. (1887), p. 480, pl. xiv. fig. 4.

† A. S. Woodward, 'Catalogue of Fossil Fishes in the British Museum,' part i. (1889), p. 351.

and the great extent of the anal fin, seemed to justify at least its generic separation. At the same time it was suggested that many so-called teeth of *Odontaspis* from the Cretaceous formations of other parts of the world might truly belong to *Scapanorhynchus*, and in that case would indicate the very wide distribution of this shark in the seas at the close of the Mesozoic era. It was also remarked that while all the teeth in the two typical species from the Lebanon seemed to bear a pair of lateral denticles, the hinder teeth alone possessed these denticles in certain other species, *e. g.*, in *Scapanorhynchus raphiodon* from the European Chalk*.

Within the last ten years nothing of importance has been added to our knowledge of the Cretaceous *Scapanorhynchus*; but quite recently, in the present writer's opinion, new information on the subject has come from an unexpected source. A shark in all essential respects identical with the supposed extinct genus in question has been described by Dr. D. S. Jordan† from the deep sea off Yokohama, Japan. It was obtained from a fisherman by Mr. Allen Owston, of Yokohama, and presented by him to the Zoological Museum of the University of Tokio. It was lent to Dr. Jordan for description by Prof. Mitsukuri, and has received the new generic and specific name, *Mitsukurina Owstoni*. The shark is recognized by Dr. Jordan as more nearly related to *Odontaspis* than to any other surviving genus; but, for reasons not definitely formulated, it is considered to be the type of a distinct family, Mitsukurinidæ.

The Lebanon fossils, of course, are marred by many imperfections; but it appears that, in all the generic characters which can be compared, the living *Mitsukurina* agrees with the Cretaceous *Scapanorhynchus*. Generic differences may still be found, but they have yet to be pointed out. Like that of the recent fish, the skeleton of the fossil may be appropriately described as flexible. The elongated rostrum is identical in the two cases, only relatively longer in the extinct species from Mount Lebanon. The fossils naturally do not exhibit the peculiar indentation between the mouth and the rostrum. One specimen of *Scapanorhynchus Lewisi* (Brit. Mus. no. 49474) clearly shows four branchial clefts immediately in front of the pectoral fin, so that the fifth

* See especially figures by A. S. Woodward, "Notes on the Sharks' Teeth from British Cretaceous Formations," Proc. Geol. Assoc. vol. xiii. (1894), p. 196, pl. v. figs. 11-13.

† D. S. Jordan, "Description of a Species of Fish (*Mitsukurina Owstoni*) from Japan, the Type of a Distinct Family of Lamnoid Sharks," Proc. California Acad. Sci. [3] Zool. vol. i. no. 6 (1898).

would doubtless be above the base of the pectorals, as recorded by Jordan in *Mitsukurina*. Another specimen (Brit. Mus. no. P. 4769) shows that the teeth in *S. Lewisi* are about as numerous as in *Mitsukurina Owstoni*, while, as in the latter species, those at the mandibular symphysis are slightly larger than those at the front of the upper jaw. All the fins are known in the two fossil species from Mount Lebanon except the anterior dorsal; and on comparing the figure of such a specimen as B. M. no. P. 4020* with that of the recent fish given by Jordan, it will be observed that the differences in proportions are not of greater than specific value. The arrangement of the basal cartilages of the fins, so beautifully represented by Jordan, is unfortunately not distinct in any of the Lebanon fossils; nor is there any clear evidence of the claspers. The dense shagreen seems to be similar in the recent and fossil forms.

The type specimen of *Mitsukurina Owstoni* measures slightly more than a metre (42 inches) in length, and is described as apparently young. The known specimens of *Scapanorhynchus Lewisi* cannot have attained a greater length than 0.5 m., while the only complete specimen of *S. elongatus* measures about 0.65 m. in length. Some of the other species, however, represented in Cretaceous formations solely by their teeth, evidently attained considerably larger dimensions, and must have been very much larger even than the Japanese fish now captured. In Cretaceous seas it was evidently a dominant type among the predaceous sharks.

LXVII.—*Note on some Cretaceous Clupeoid Fishes with Pectinated Scales* (*Otenothrissa* and *Pseudoberyx*). By A. SMITH WOODWARD, F.L.S.

A RECENT detailed study of the so-called Berycidae of the Cretaceous period has led to the recognition of several allies of the herrings among them. There is evidence of at least two genera, whose osteological characters necessitate their reference to the family Clupeidae as defined in Dr. Günther's British Museum Catalogue. Both are characterized by large pectinated scales, like those of the existing Clupeoid genus *Levoortia*†; but neither exhibits any ventral or dorsal ridge-

* A. S. Woodward, 'Catal. Foss. Fishes B.M.' part i. (1889), pl. xvii. fig. 1.

† Gill, Proc. Acad. Nat. Sci. Philad. 1861, p. 37; Jordan and Evermann, "Fishes of North and Middle America," Bull. U.S. National Museum, no. 47 (1896), p. 433.

scales. The first genus has not hitherto been defined, and may receive the new name of *Ctenothrissa*; the second has already been described as *Pseudoberyx*.

CTENOTHRISSA, gen. nov.

Definition. Head large; trunk deeply fusiform and laterally compressed, but ventral border of abdomen flattened. Maxilla robust and arched, with two large supramaxillary bones; mandible deep, a little prominent, and gape of mouth not extending behind the middle of the large orbit; minute teeth on the margin of the jaws. Preoperculum only slightly expanded; operculum and suboperculum deep and narrow. Vertebrae from 30 to 40 in number, half being caudal. Pelvic fins much enlarged and inserted far forwards; dorsal fin much deepened, occupying about half of the back; anal fin small; caudal fin deeply cleft. Scales pectinated, large and regularly arranged, none enlarged or thickened, and no dorsal or ventral ridge-scales; lateral line conspicuous.

Type. So-called *Beryx vexillifer*, Pictet, from Upper Cretaceous, Hakel, Mount Lebanon.

The three best-known species are:—

(1) *Ctenothrissa vexillifer*, Pictet, sp.

Originally referred to *Beryx* by F. J. Pictet (Descript. Poiss. Foss. Mt. Liban (1850), p. 8, pl. i. fig. 1). The fine series of specimens of this species in the British Museum clearly shows the Clupeoid head, which, indeed, is partly represented in the restoration by Pictet and Humbert (Nouv. Rech. Poiss. Foss. Mt. Liban (1866), pl. ii. fig. 3). The premaxilla is very small and the loose arched maxilla relatively large, with two supramaxillaries, as in *Clupea*. It is quite clear that none of the fin-rays are spinous. The largest specimens are about 0·07 m. in length, and the specific characters may be briefly stated as follows:—Length of head with opercular apparatus approximately equal to the maximum depth of the trunk, and contained about one and a half times in the length from the pectoral arch to the base of the caudal fin. 30 vertebrae. Pectoral fins about half as long as the pelvic pair, which are inserted beneath the former and comprise 8 stout rays, the foremost only articulated distally, the others both divided and articulated distally, the longest when adpressed to the trunk reaching the anal fin; dorsal fin with 18 to 20 rays, the sixth longest; anal fin with 13 or 14 rays, opposite the hinder third of the dorsal. Scales very finely pectinated. Known only from the Upper Cretaceous of Hakel, Mount Lebanon.

(2) *Ctenothrissa radians*, Ag., sp.

Originally referred to *Beryx* by Agassiz (Poiss. Foss. vol. iv. pp. 4, 118, pl. xiv. *b.* fig. 7, pl. xiv. *c.* figs. 7-9). Several specimens of this species in the British Museum exhibit the typical Clupeoid head, one (no. P. 5699) being especially well preserved and displaying the minute teeth both on the maxilla and premaxilla. None of the fin-rays are spinous, the appearance of a pelvic spine in the type specimen, as described by Agassiz, being proved by other specimens to be deceptive. The species attains a length of about 0.25 m., and may be briefly defined thus:—Head with opercular apparatus relatively smaller than in *C. vexillifer*, and marked with a fine rugose ornament. About 40 vertebræ. Pelvic fins with 7 or 8 stout rays, which, when adpressed to the trunk, extend to the anal fin; anal fin with at least 12 rays, arising opposite the hinder end of the dorsal fin. Scales very finely pectinated; lateral line extending along the ninth series above that which forms the ventral border of the flank. Common in the Lower Chalk of England.

(3) *Ctenothrissa microcephala*, Ag., sp.

Originally referred to *Beryx* by Agassiz (*tom. cit.* pp. 4, 119, pl. xiv. *b.* figs. 3-6, pl. xiv. *c.* fig. 10). As in the two preceding species, so in this, the British Museum collection demonstrates the presence of a Clupeoid head and the absence of fin-spines. This fish is rather elongated and attains a length of about 0.15 m. The length of the head with opercular apparatus equals the maximum depth of the trunk and is contained about twice in the length from the pectoral arch to the base of the caudal fin. Fins apparently as in *C. radians*, but the pelvic fins less elongated. Scales relatively large and coarsely pectinated; lateral line extending along the fourth series above that which forms the ventral border of the flank. Common in the Lower Chalk of England.

PSEUDOBERYX, Pictet and Humbert.

[Nouv. Rech. Poiss. Foss. Mt. Liban, 1866, p. 32.]

Definition. Head and opercular apparatus as in *Ctenothrissa*. Vertebræ approximately 30 in number, half being caudal. Paired fins small, the pelvic pair inserted opposite the dorsal, which is short-based and nearly median; anal fin smaller than the dorsal; caudal fin deeply cleft. Scales pectinated, large and regularly arranged, none enlarged or thickened, and no dorsal or ventral ridge-scales.

Type. *Pseudoberyx syriacus*, Pict. & Humb. (*op. cit.* p. 33, pl. ii. figs. 4-6).

The two species, *P. syriacus* and *P. Bottæ*, have already been sufficiently well defined by Pictet and Humbert (*op. cit.*), and an imperfectly defined larger species, *P. grandis*, is described by J. W. Davis (Trans. Roy. Dublin Soc. [2] vol. iii. (1887), p. 510, pl. xxviii. fig. 4). An examination of the original specimen of *P. longispina*, Davis (*loc. cit.* p. 511, pl. xxv. fig. 2), convinces me that it does not belong to this genus, but is referable to an entirely distinct fish commonly known as *Clupea Bottæ*, Pict. & Humb. *Pseudoberyx* has hitherto been found only in the Upper Cretaceous of Hakel, Mount Lebanon.

LXVIII.—*Four new Bees of the Genus Perdita collected by Dr. L. O. Howard in Mexico.* By T. D. A. COCKERELL, New Mexico Agricultural College.

Perdita Howardi, sp. n.

♀.—Length about 6 millim.

Bright lemon-yellow; tips of mandibles darkened; frontal fovea a black stripe; a narrow black line extending from each lateral ocellus to the adjacent eye; abdomen with four narrow entire black bands at the sutures between the segments; second abdominal segment with a longitudinal black stripe on each extreme side; pleura without any black patch; tarsi more or less fuscous; stigma faintly tinged with yellowish; nervures colourless; marginal cell obliquely truncate, its substigmatal and poststigmatal parts about equal in length; second submarginal cell narrowed rather more than half to marginal; third discoidal distinct. Head ordinary; lower part of face pellucid white; mesothorax naked, a very narrow black line along its anterior margin; tegulæ colourless, transparent.

♂.—Frontal fovea a black dot; no line from the ocelli to the eyes; abdominal bands more obscure; otherwise like the female. Claws cleft.

Hab. S. José de Guaymas, Mexico, April 10, 1898 (*L. O. Howard*).

It is a pleasure to name this beautiful species after its well-known and esteemed discoverer. *P. Howardi*, by its yellow colour and the absence of a black patch on the pleura, comes near to *luteola*, from which it is easily distinguished by the abdominal bands. It is also a vernal species, whereas *luteola* is autumnal. Seven specimens were obtained.

Perdita Ashmeadi, sp. n.

♀.—Length about $4\frac{1}{2}$ millim.

Head and thorax shining dark olive-green; abdomen

yellowish beneath; tubercles and face-marks cream-colour; legs yellow, tarsi brownish; a patch at end of hind femora, hind tibiæ, and tarsi brown. Head subquadrate, but not particularly large, broader than long; clypeus low and broad; mandibles cream-colour, black at tips and reddish just before tips; labrum and clypeus cream-colour, the latter with the usual dots, and two longitudinal stripes vaguely indicated by brownish stains; supraclypeal mark present, produced above for a short distance as a narrow stripe or line, separated below from the clypeus by a distinct interval; dog-ear marks present but extremely minute, not nearly touching the clypeus; lateral marks consisting of a broad stripe below, abruptly narrowing just above the level of the antennal sockets to a narrow stripe, which continues along the orbital margin as far as the level of the middle ocellus; scape with a yellow or cream-coloured stripe beneath; flagellum very dark brown above, somewhat paler beneath; face and front without any conspicuous pubescence; cheeks very thinly pubescent; front granular. Mesothorax very shiny, very thinly pubescent, with a median furrow on its anterior half; metathorax bluer; pleura wholly dark; tegulæ transparent, with a cream-coloured spot; stigma pale brownish, with a darker margin; nervures brown, marginal cell obliquely truncate, appendiculate; second submarginal narrowed about one half to marginal, third discoidal distinct.

Var. *a*.—Hind border of prothorax yellow; second abdominal segment with a short transverse yellow stripe near the base; ventral surface of abdomen clear yellow.

Hab. S. José de Guaymas, Mexico, April 10, 1898 (*L. O. Howard*).

Named after the most active student of American Hymenoptera. In my table of *Perdita* in Bull. Denison Lab., *P. Ashmeadi* comes near to ♂ *crassiceps*, but it differs from that in many particulars. The var. *a* resembles rather *tarda*, but is easily separated from it.

Perdita sonorensis, sp. n.

♀.—Length about 6 millim.

Black, with a metallic lustre and cream-coloured markings. Head ordinary; front strongly æneous or dark olive-green, with scattered distinct punctures; clypeus cocked-hat-shaped, cream-coloured, with the usual black dots rather large, and two median longitudinal black bars, very broad and slightly coalescing; labrum black; mandibles ordinary, basal half cream-colour, apical half rufous; face not very hairy; a distinct linear groove running down from middle ocellus; antennæ dark, flagellum light brown beneath; lateral face-marks triangular, rapidly narrowing from a broad base to a point on

a level with the antennal sockets; supraclypeal mark a transverse band, more than twice as broad as long; dog-ear marks present, separated by an interval from the lateral marks. Mesothorax very shiny, with scattered punctures, greenish and hairy in front, otherwise black and nearly nude; hind margin of prothorax with an interrupted cream-coloured band; tubercles cream-coloured, with a dark spot; metathorax dark bluish, contrasting with the black scutellum and postscutellum; tegulæ hyaline, with a cream-coloured spot; stigma hyaline, with a brown margin; nervures brown; marginal cell with the poststigmatal portion a little the longest; second submarginal large, narrowing rather more than half to marginal; third discoidal very distinct; legs brown-black, anterior knees and anterior tibiæ in front cream-colour; abdomen black, with straight pale yellow bands, more or less interrupted in the middle, at the extreme bases of segments 2 to 4, and two spots representing a rudimentary band on the fifth segment. Ventral surface dark.

Var. *a*.—Clypeus all black, except a minute mark at each side adjacent to the lateral face-marks; fifth abdominal segment without spots.

Var. *b*.—Clypeus black, with the lateral corners cream-coloured; dog-ear marks mere specks; the three abdominal bands reduced to inconspicuous widely separated pairs of yellowish stripes.

Hab. S. José de Guaymas, Mexico, April 10, 1898 (*L. O. Howard*). Four specimens.

Related to *P. sexmaculata*. In my table of *Perdita* in Proc. Phil. Acad. 1896, it comes close to *P. exclamans*, from which it is separated by many characters. The var. *b* approximates to *tarda*, but is not really related to that insect.

Perdita Luciae, sp. n.

♂.—Length about 4 millim.

Bright lemon-yellow, with dark markings. Head ordinary, cheeks unarmed; face nude, entirely yellow except the black dots representing the frontal foveæ; cheeks yellow, sparsely hairy; vertex dark metallic green; scape yellow, with a black spot at the top behind; flagellum yellow beneath and blackish above; prothorax and sides and under part of thorax entirely yellow; mesothorax practically nude, very shining dark metallic olive-green, with the lateral margins narrowly yellow, and a yellow patch near the hind margin; scutellum yellow, with the sides dark; postscutellum similarly coloured; metathorax dark blue dorsally, yellow at sides; tegulæ hyaline; stigma hyaline, with a sepia-brown margin; nervures light brown; marginal cell obliquely truncate, with its substigmatal

about one half to marginal; third discoidal indistinct; legs entirely yellow except a brown stripe on the posterior tibia and tarsus; abdomen yellow, with five broad entire dark brown bands, or the fifth subobsolete, and the base of the first segment dark; venter entirely yellow. Claws cleft. Tips of mandibles bright rufous.

Hab. S. José de Guaymas, Mexico, April 10, 1898 (*L. O. Howard*).

Named after Dr. Howard's little daughter. This in my tables comes near to *P. Martini*, but is easily distinguished by the yellow sides of the thorax and the brown nervures. Seven specimens. There are sometimes two yellow spots on the anterior half of the mesothorax.

Dr. Howard also collected at S. José de Guaymas, on the same day, examples of *P. tarda*, Ckll., var. *P. salicis*, Ckll. (1 ♂), *P. punctosignata*, Ckll., and *P. exclamans*, Ckll. (♂ ♀). He informs me that most, if not all, of the specimens of *Perditia* from that locality were taken at the flowers of mesquite (*Prosopis glandulosa*).

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

April 26th, 1899.—W. Whitaker, B.A., F.R.S.,
President, in the Chair.

The following communication was read:—

‘On three Species of Lamellibranchs from the Carboniferous Rocks of Great Britain.’ By Wheelton Hind, M.D., B.S., F.R.C.S., F.G.S.

The first part of this paper describes a new species of *Anthracomya* which occurs in the North Staffordshire and Manchester Coal-fields at horizons higher than that characterized by *A. Phillipsi*. The fossil is found at Etruria, Bradwell, Stoke-on-Trent, and Fallowfield. It appears to indicate a special zone of shales and *Spirorbis*-limestone about 300 feet below the Penkhull Sandstone, and to be the only molluscan form known from the zone.

A new species of *Carbonicola* is next described, partly from specimens previously supposed to be a gasteropod, a brachiopod, or even a crustacean, and partly from better-preserved specimens obtained from calcareous bands about 10 yards above the Bassey Mine Ironstone in North Staffordshire. It appears to be the latest species of this genus known, and to occur in higher beds than any other species.

Lastly, a new species of *Otenodonta* from Penton Linns (Dumfriesshire) is described. It occurs in a marine shale below the highest limestone of the locality, in beds referred to the horizon of the Hurlet Limestone by the officers of the Geological Survey. The bed contains gasteropods, crinoids, cephalopods, etc., with *Productus giganteus*. The species has some resemblance to *C. Halli*, Barrois, found in Spain.

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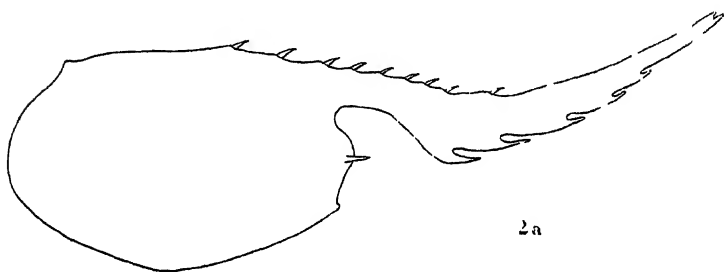
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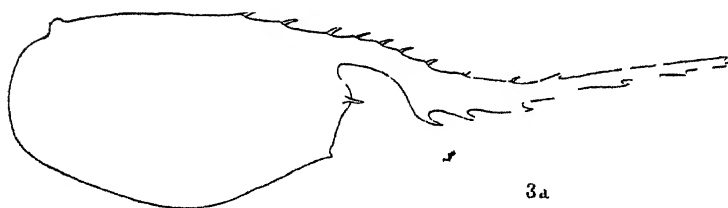
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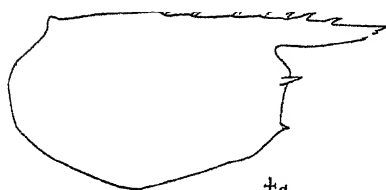
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2a



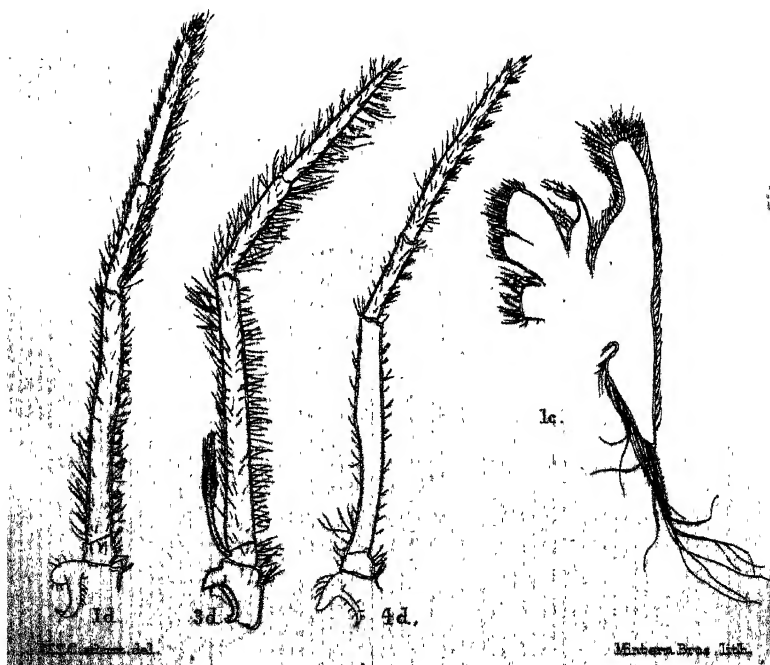
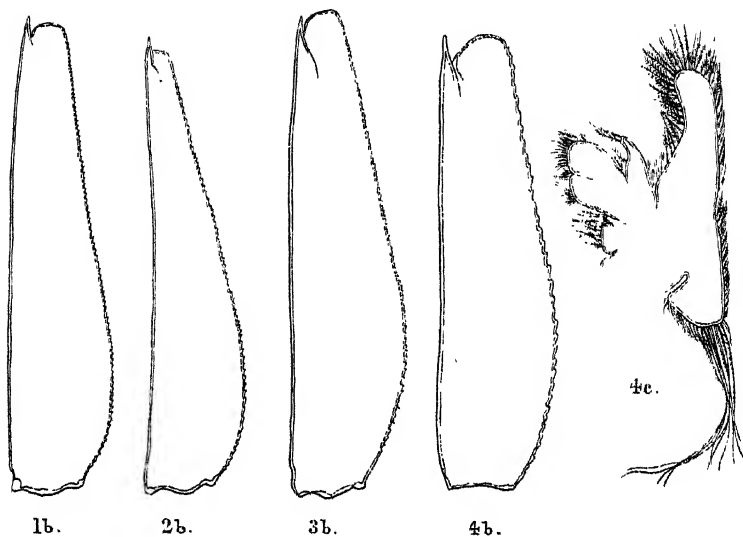
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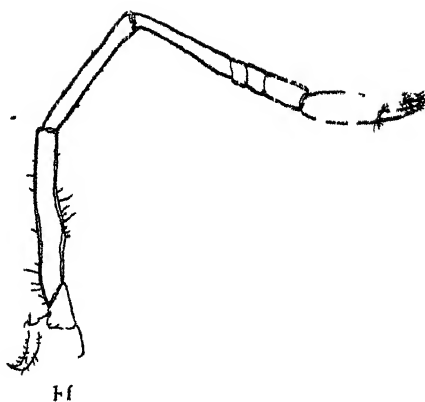
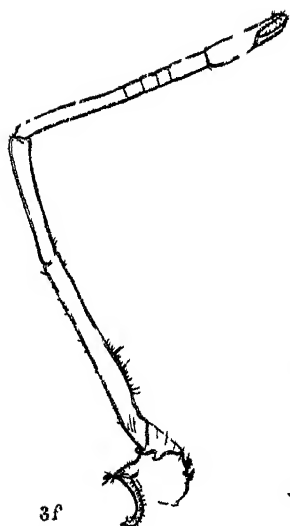
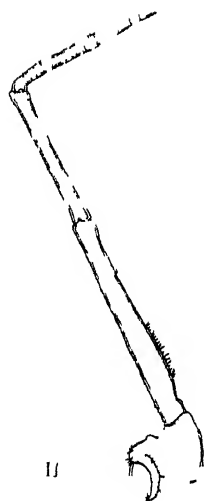


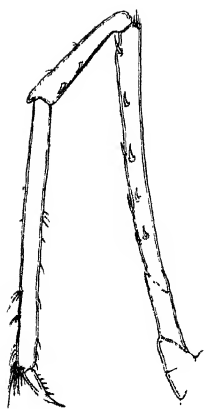
4a



1e







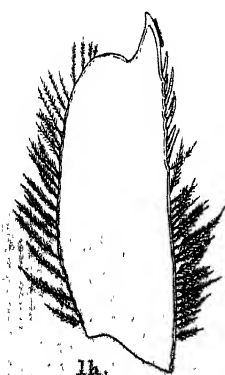
1g.



2g.



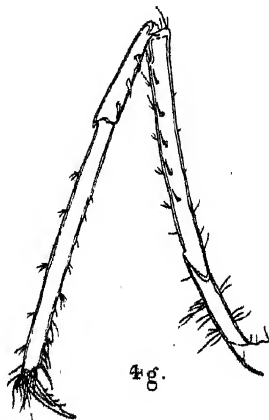
3g.



1h.



1k.



4g.



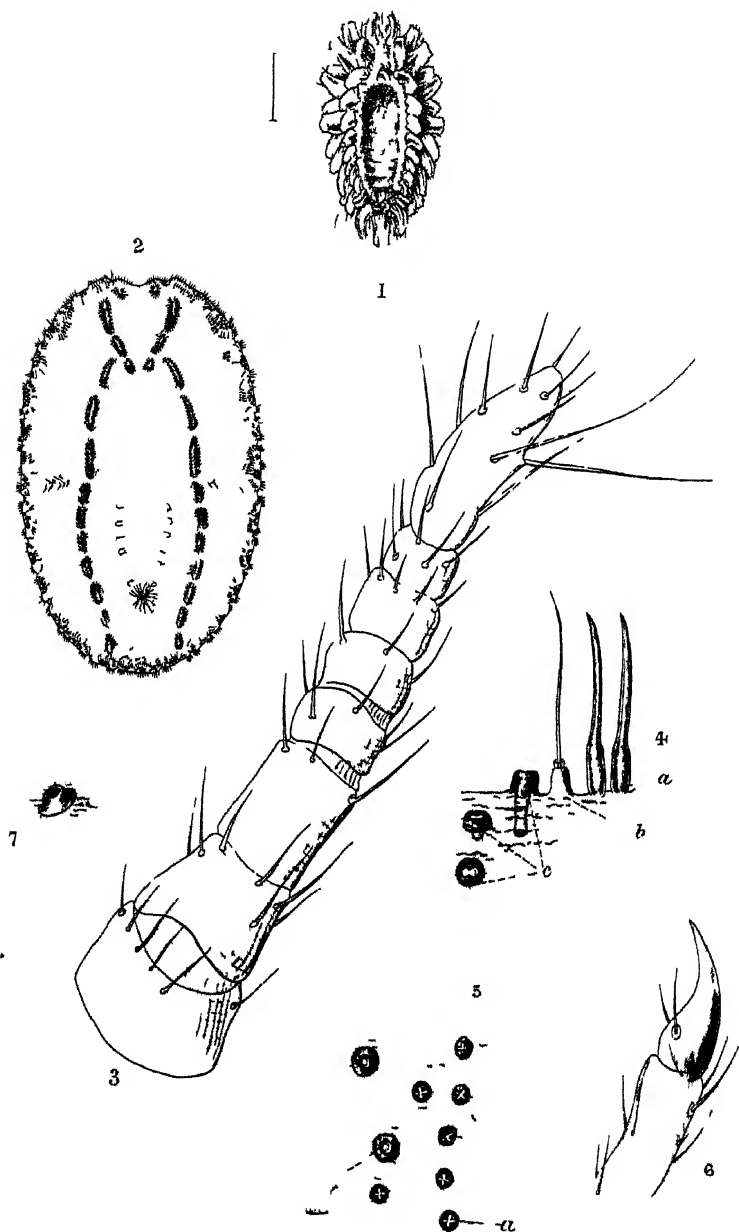
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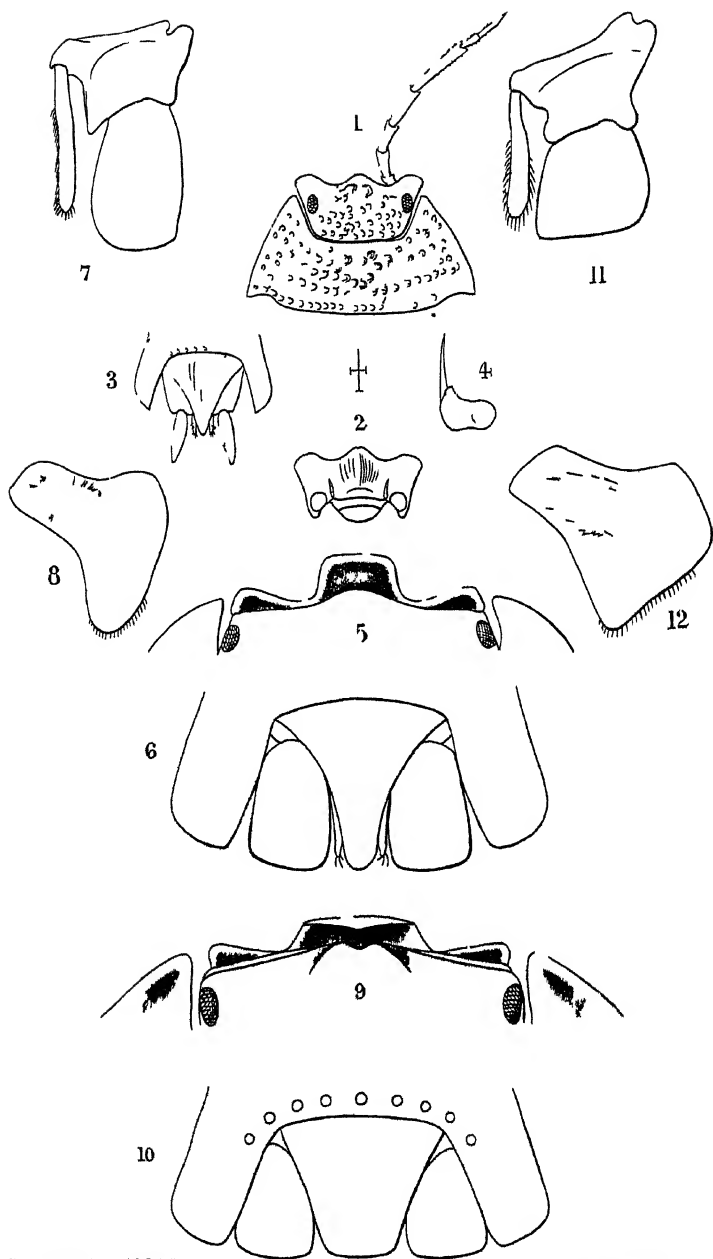


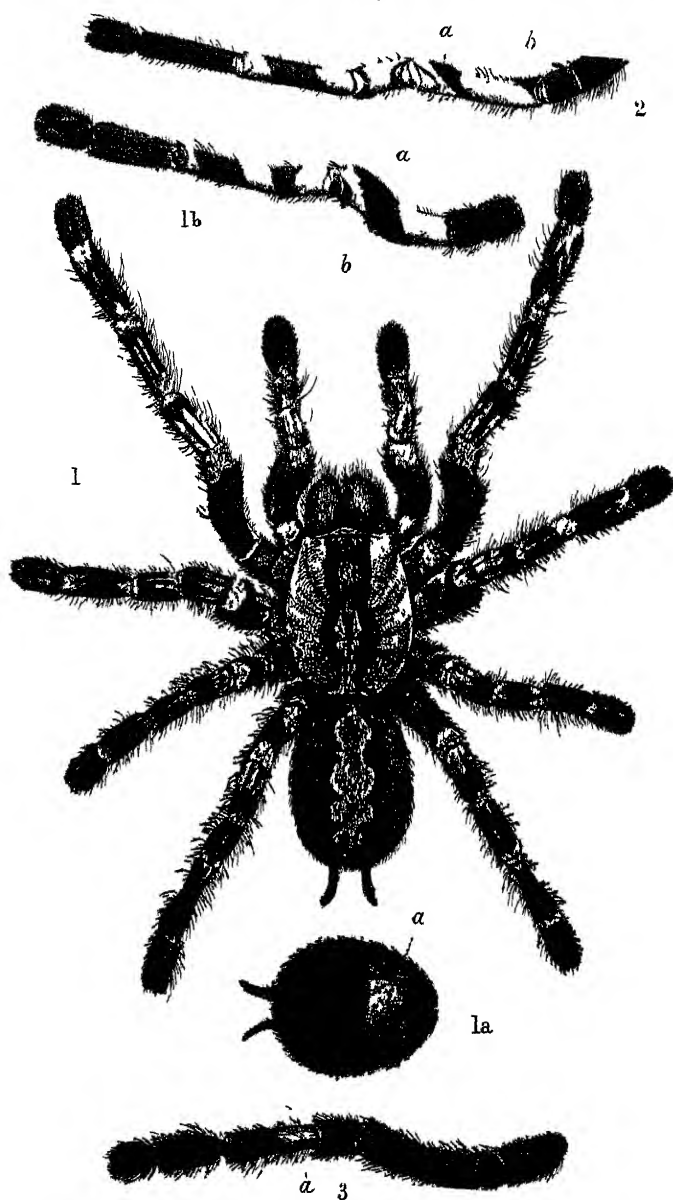
3h.



4h.







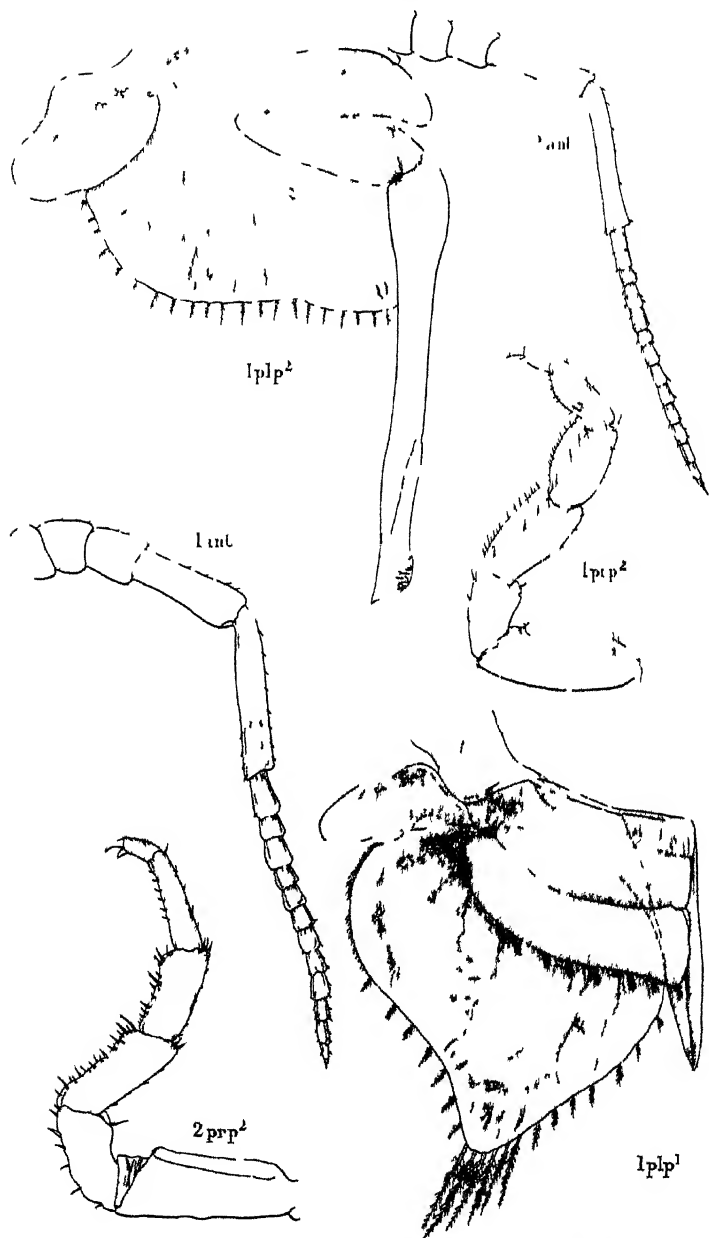


Fig 1
x 3



Fig 5
x 15



Fig 12
x 12



Fig 13
x 12



Fig 7
x 13



Fig 9
x 90

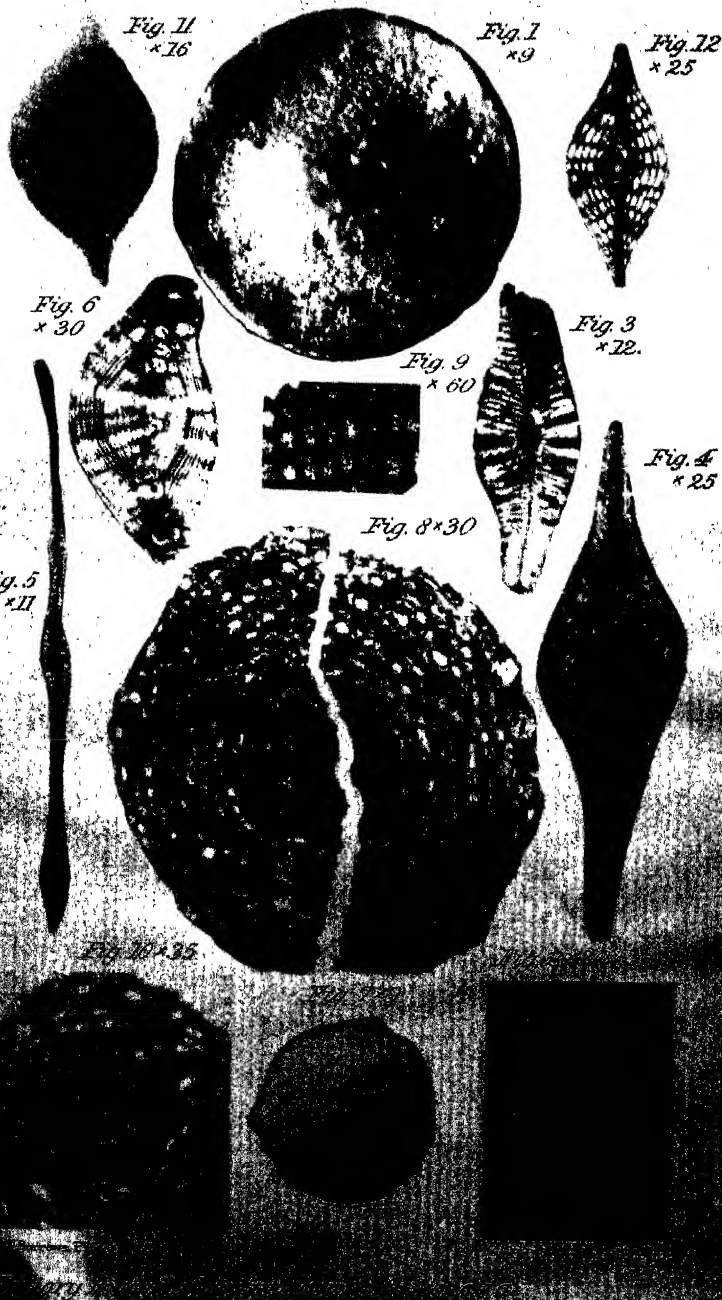


Fig 3 x 10



Fig 10 x 14





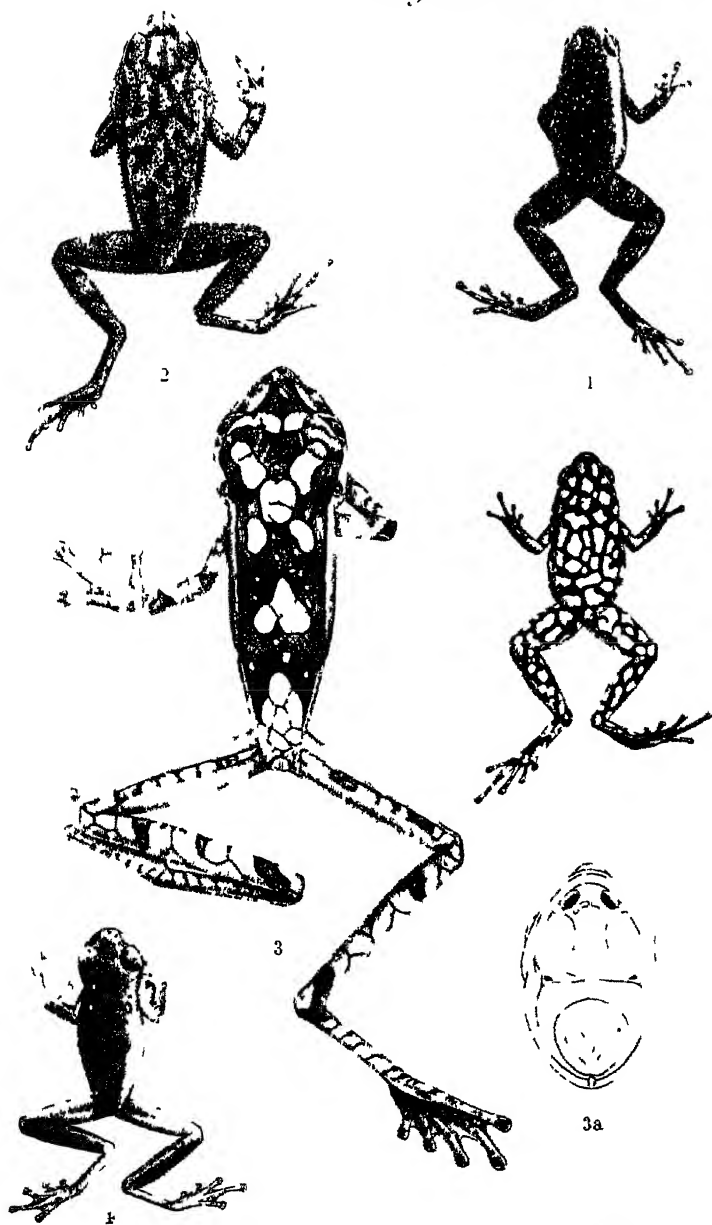


J Green del et lith

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Minton Bros imp

1 RANA LARUTENSIS 2 RAPPIA PHANTASTICA
3 PHYLLOBATES PRATTI 4 DENDROBATES OPISTHOMELAS



J Green. del et lith.

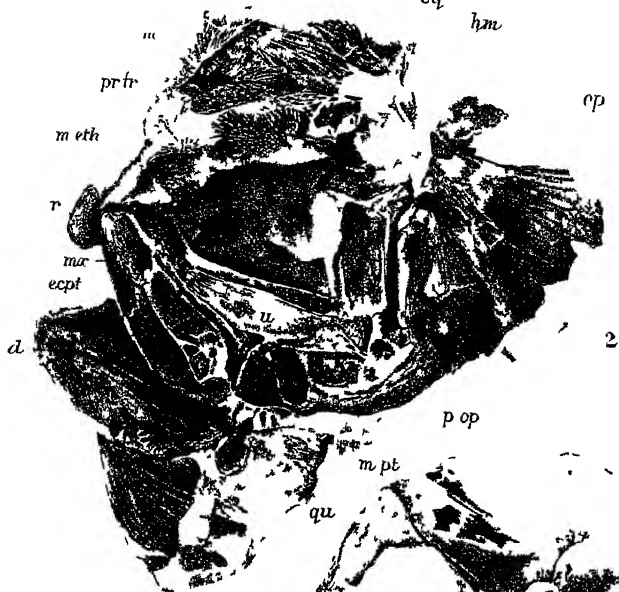
Mintern. Bros imp

1 MICROHYLA LEUCOSTIGMA 2 BUFO GRACILIPES
3 HYL A PICTURATA 4 HYL A OCELLIFERA



fr pt tr pa s t sq

hm

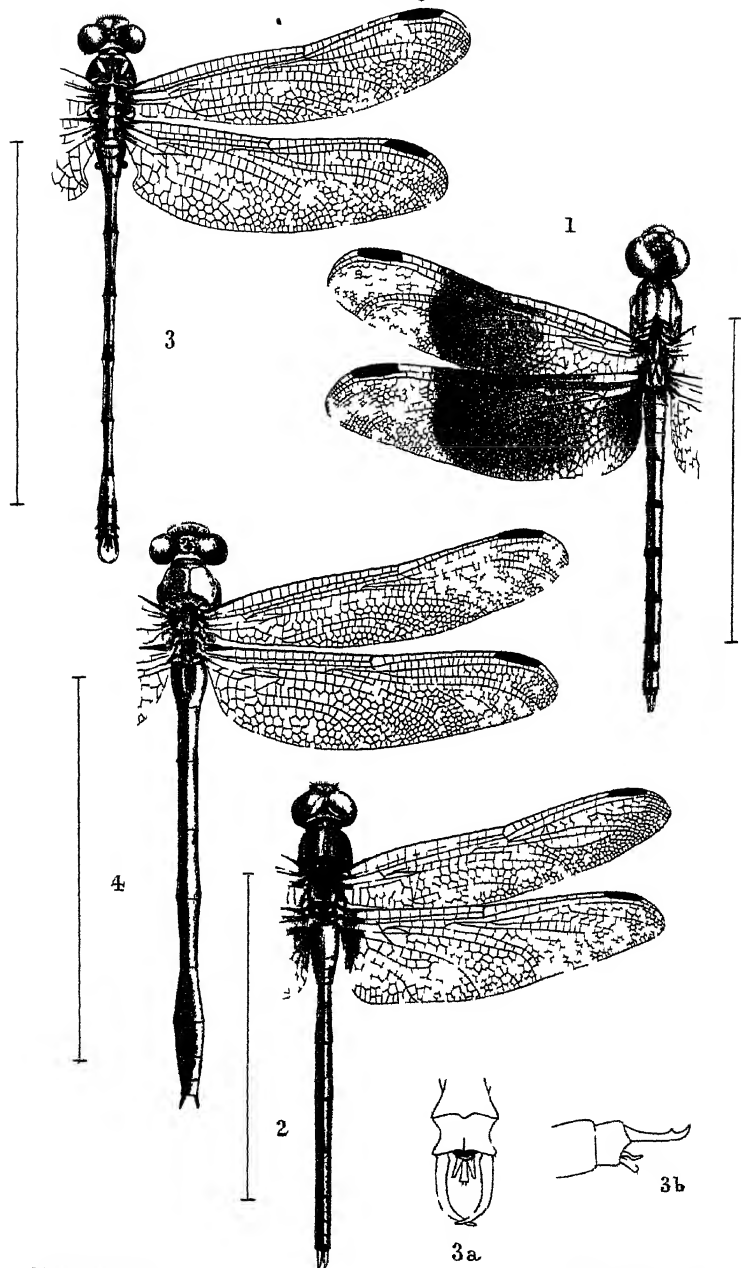


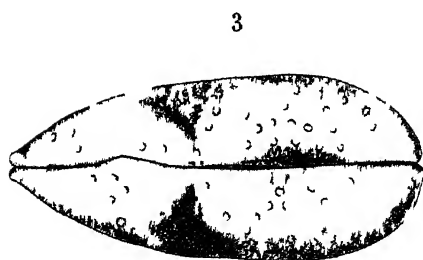
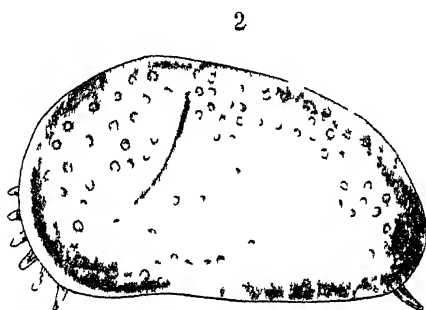
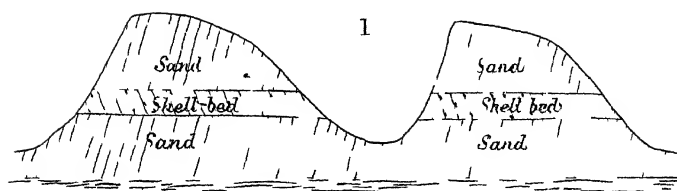
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I. A. B. I. 75.

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